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. . . . . *but by no means farewell to the*

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Waterbury, Conn.

Specialists in the Production of Clean-Working Buffing and Polishing Compounds

VOL. 38, NO. 9 METAL FINISHING SEPTEMBER, 1940
PREPARATION, ELECTROPLATING, COATING

Discoloration of Cadmium Plate

A troublesome phenomenon of warm, humid weather is the discoloration of cadmium plate. The discoloration consists of an iridescent film which changes at first from golden yellow to brown, then to purplish blue and finally black.

The mechanism of the discoloration process is not clear but it appears to be due to the decomposition of cyanide, or from ammonium salt residues on the surface of the plate. Storing without air circulation, particularly in warm and humid weather is a contributing factor. The staining is purely a surface condition and is not correlated with plating solution composition, thickness of plate or operating conditions.

Unbright dipped plate and plate dipped in dilute nitric acid alike are prone to discoloration under the conditions described. Ammonium salts can form from traces of cyanide on the work or by reduction of nitrate from the reaction between nitric acid and metal. The cure for the discoloration can be effected by removal of the chemicals contributing to the corrosion and by storing so as to allow free circulation of clean air.

Neutralization of the salts causing discoloration can be accomplished by relatively strong oxidizing agents which in themselves do not discolor cadmium. Such solutions, for example, as weak alkaline permanganate, perborate, or chromic acid are effective.

Solutions of chromic acid and sulfuric acid or other sulfates (Patents held by Udylite Corp., Detroit, Mich.) are effective brighteners and also remove the stain inducing chemicals. Weight ratios of chromic acid to sulfate must be kept above 20 to prevent yellow film formation. This yellow film and also a film formed from excessive tri-valent chromium, if not removed, may also cause the cadmium to turn bluish-black. The film can be removed in a weak sulfuric acid solution (½—2% by weight) but cadmium surfaces so treated do not have the tarnish resistance of simple chromic acid dipped surfaces.

Zinc does not blacken under the conditions described for the cadmium discoloration, but zinc surfaces are more sensitive to moisture, turning into a hazy white surface when exposed to damp conditions. The brighter the finish, the less apparent degree of tarnishing. Both bright zinc and cadmium surfaces in dry non-corrosive atmosphere will remain bright indefinitely. We must remember, however, that both metals, by virtue of their ability to protect iron against corrosion, must a priori, have little corrosion resistance themselves.

Cathode Agitation

The expediencies of cathode agitation have been known for a long time. Silver platers have been able to double the operating current density of silver plating by employing an oscillating or up and down motion of the cathode. The limit of employable current density depends on the availability of metal ions at the cathode film and the limits of current density possible to attain by agitation of the work are still unknown.

In England, air agitation, particularly of nickel solutions, has found considerable use, but on consideration of the problem, air agitation does not appear as the most practical way of accomplishing effective replenishing of the cathode film. What is required is relative movement between the work and the body of the solution. This is accomplished by movement of the work.

Current densities over 1000 amperes per square foot are possible on fast moving wire whereas the limit for still plating in the same solution would be from 50 to 100 amperes per square foot.

Economical devices are on the market for agitating the cathode rods of still tanks, and their installation will pay dividends. Agitation may require filtration because solid particles in the solution may cause roughness. However, the use of agitated, filtered solutions may accomplish a 50% reduction in plating time with a corresponding increase in production.

Surface Tension of Plating Solutions

By Derick S. Hartshorn, Jr.

Technical Director, The Enthone Co., New Haven, Conn.

A discussion of surface tension phenomena. Mechanism of wetting and tools for measuring wetting agents are considered. Requisites of good wetting agents for plating use and applications of wetting agents are described.—Ed.

Mechanism of Wetting

WETTING agents or surface tension depressants have proved their value in the plating industry within the past three years. They were first introduced as anti-pitting agents in several of the bright nickel solutions where their application was essentially what the name implies—an agent to prevent pitting. Since their introduction, they have been adopted for use in many proprietary cleaners and are also being used in pickling solutions.

A wetting agent may be defined as a material which when added to an aqueous solution will lower its surface tension. Many materials including soaps, organic acids, some colloids, and salts may come within the scope of this definition. In particular, there has recently been developed a large number of compounds specifically intended to be used as wetting agents[1]. Examples of this class of compounds are the organic alkali sulphonates of aryl and alkyl alcohols.

Derick S. Hartshorn, Jr.

When a strip of metal is immersed in a liquid such as water, there are two forces at work at the interface between the water and the metal. One of these forces is the surface tension of the liquid; this force tends to draw the liquid away from the surface of the metal. The other is the adhesive force between the liquid and the metal tending to draw the liquid closer to the metal surface. Together these forces make up what is known as the interfacial tension between the liquid and the metal surface. If the adhesive forces are stronger than the surface tension forces, the liquid will be drawn very close to the metal surface; we say that the liquid "wets" the metal. On the other hand, if the surface tension forces are greater than the adhesive forces, the liquid will draw away from the metal surface and the metal is not "wetted."

Even if the metal is normally wetted when it is absolutely clean, the presence of dirt particles or gas bubbles at the interface may keep the liquid from completely wetting the surface. The dirt particles and gas bubbles prevent contact between the metal and liquid in their vicinity and to all intents and purposes, the adhesive forces are non-existent. Consequently the surface tension forces will tend to hold the dirt particles or bubbles at the interface.

However, other forces are acting on the gas bubbles and dirt particles. The hydrostatic pressure of the liquid is continually trying to force the bubbles to the surface. In addition to hydrostatic pressure, gravitational forces are acting on the dirt particles and they may drop to the bottom of the liquid. When the hydrostatic pressure is greater than the surface tension forces, the gas bubbles will rise to the liquid surface; conversely when the surface tension is greater than the hydrostatic pressure, the bubbles will continue to adhere to the liquid-metal interface. Similarly if the surface tension is greater than the gravitational force-hydrostatic pressure resultant on the dirt particles, they too, will be held at the liquid-metal interface.

The addition of wetting agents to a liquid, particularly to aqueous solutions which normally possess high surface tension, produces a substantial decrease in the surface tension of the liquid. When the surface tension is thus decreased two things happen: first, the adhesive forces between the metal and liquid are not opposed by as great a counter force and are permitted to act more strongly in drawing the liquid closer to the metal surface; the metal is "wetted" more easily. The second result in surface tension is the greater ease with which gas bubbles are released and dirt particles are removed from the metal surface.

Surface tension is measured in dynes per centimeter and represents the force required to extend the surface of the liquid along a line one centimeter long. One dyne is equivalent to approximately the gravitational force exerted on a one milligram weight. Distilled water has a surface tension of about 73 dynes per centimeter, while nickel solutions with wetting agents may run as low as 30 dynes per centimeter.

Many methods have been used to measure the surface tension of solutions but those most familiar to the

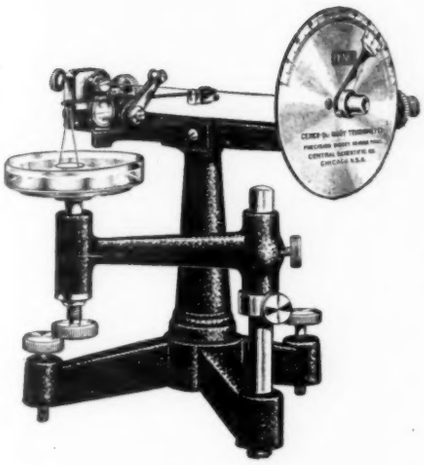


Fig. I. A Du Nouy tensiometer.

Fig. II. Stalagmometers in case.

plater and chemist are the Traube Stalagmometer, Fig. I, the Du Nouy Tensiometer, Fig. II, and the graduated capillary tube in which the surface tension is measured by the rise of the solution due to its capillary action.

Stalagmometer

The Traube stalagmometer is essentially a glass tube to which a capillary tube is sealed at the lower end. The tip of the capillary tube is flattened, ground, and polished to increase the dropping surface. The stem is enlarged to form a bulb or reservoir, and above and below the bulb the stem is graduated so that fractions of a drop may be estimated.

The solution to be tested is drawn into the tube as far as the upper marking and is allowed to run out until the level reaches the lower marking. The surface tension is calculated from the number of drops of solution escaping from the measured volume as compared with the number of drops of distilled water escaping from the same instrument and at the same temperature by substituting the following formula:

$$T_x = \frac{T_{H_2O} \cdot (\text{No. of drops of } H_2O) \cdot D_x}{\text{No. of drops of x}}$$

where T_x = Surface tension of unknown solution in dynes per cm.

T_{H_2O} = Surface tension of distilled water = 73 dynes per cm. at 25 deg. C.

x = The solution tested.

D_x = Density of the solution tested.

If the stalagmometer is thoroughly cleaned before each determination, the above formula may be simplified by establishing the water constant W and accurately determining the number of drops of distilled water delivered at 25°C.

W = 73 (No. of drops of distilled water.)

Substituting in the first formula we obtain:

$$T_x = \frac{W \cdot D_x}{\text{No. of drops of x}}$$

Tensiometer

Undoubtedly, the most popular method is the Du Nouy ring method. The Du Nouy tensiometer is limited in some applications, but is well-suited for surface tension measurements required by the plater and control chemist. For this application it permits quicker and more accurate determinations than those obtained by either of the other methods previously described. It consists of a support to which is mounted a sensitive torsion balance which measures the slowly increasing upward force exerted on a platinum-iridium ring in contact with the surface of the liquid under measurement. The values are given directly in dynes of force exerted and represent the force required to separate the platinum-iridium ring from the liquid being measured.

Where none of these methods is available, it is sometimes necessary to estimate the quantity of wetting agents by visual inspection of the plated metal, additions of the wetting agent being made at the first appearance of pitting.

If the solution is analyzed when the wetting agent is added, the operator may obtain some idea of its concentration by periodic analysis of one or more constituents which do not plate out or decompose. It may be assumed that the dragout of these ingredients is proportional to that of the wetting agent. This method, of course, is not satisfactory for estimating wetting agents that decompose.

Requisites of Wetting Agents

In selecting a wetting agent for a nickel solution, one should be familiar with its limitations and know what can reasonably be expected. Essentially, a wetting agent is expected to reduce the surface tension of a nickel solution sufficiently to eliminate pitting by permitting the hydrogen bubbles to escape to the surface as soon as they are formed. In addition to eliminating pitting some wetting agents will produce a brighter and more ductile deposit which is easier to buff. It may also widen the operating range with respect to pH, temperature or current density, or it may increase the throwing power. These advantages are worthy of consideration but the selection should not be made without also considering the following limitations of the wetting agent in question.

The wetting agent should reduce the surface tension to 30-32 dynes per cm. in concentrations of not over ½ oz. per gallon of solution. Pitting may be eliminated in some nickel solutions by reducing the surface tension to 60 dynes per centimeter but a greater

decrease is usually desirable if other advantages are required.

It should be stable within a pH of 2.5 to 6.0 at temperatures as high as 180 deg. F. in the presence of nickel salts. This quality may be investigated in the laboratory. The presence of a cloud or haze in the solution is an indication that the agent is unsuited for these conditions.

Prolonged electrolysis at high current densities should effect no change in the surface tension of the solution. If a sharp increase in surface tension is noted, it is an indication that some of the wetting agent has decomposed. This is an all too common weakness with many wetting agents. It has been suggested that the decomposition is caused by oxidation of the material at the anode. The presence of the decomposition products will cause water-breaks, rough and pitted deposits, and brittle deposits.

The wetting agent should produce a brighter and softer plate which is easier to buff, and it should not harden or embrittle the deposit. Some wetting agents will produce deposits that appear to have been buffed, but they are usually formed only within a narrow operating range.

The use of the wetting agent should not sacrifice efficiency or throwing power, neither should an overdosage result in a poor deposit.

The wetting agent should be completely and easily soluble or dispersed colloidally in the electrolyte. One which does not fulfill this requirement incurs unnecessary labor and material losses.

Materials used to lower the surface tension possess unusually good emulsifying properties, and easily emulsify the oil allowed to enter the solution. This oil may be introduced on greasy work, or from the agitator motor or conveyor. Small quantities of emulsified oil will produce deleterious effects in the nature of peeling, brittleness, or cloudy deposits. The emulsified oil, as well as some of the other impurities may be removed by filtering through activated carbon.

If the wetting agent will precipitate out in the presence of calcium, and magnesium salts, its use should be avoided with hard water. Some companies in localities where hard water is prevalent overcome this difficulty by using the condensate from the steam system. The use of hydrated lime to raise the pH of the solution, of course, should be avoided if it will precipitate the wetting agent.

Hydrogen peroxide and potassium permanganate are frequently added when chemical methods are used to purify the solution. The wetting agent employed should be stable in nickel solutions in the presence of such oxidizing agents at elevated temperatures, and at pH values between 2.5 and 6.0.

In selecting a wetting agent, operating conditions may make it possible to eliminate one or more of these requirements. The most effective wetting agent would naturally be the one possessing all of the above-mentioned advantages. However, we doubt if such a material has yet been discovered.

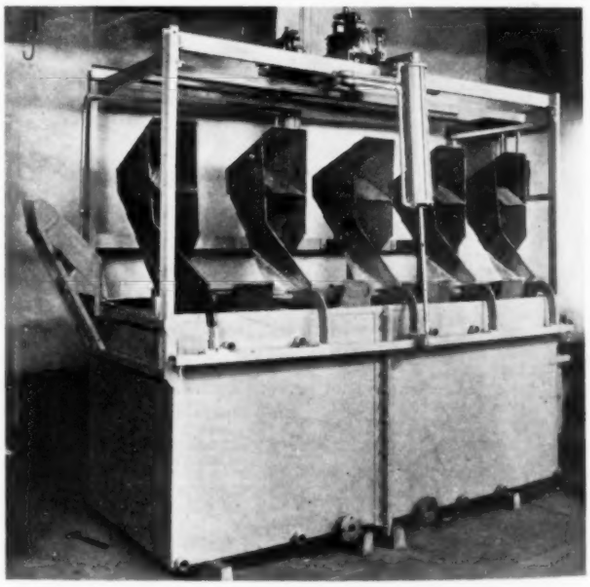
Applications of Wetting Agents

Wetting agents have replaced soap and rosin in many of the proprietary cleaners being used in concentrations of 1/10 to 2 per cent. The materials being used are particularly popular in localities where the water is contaminated with calcium and magnesium salts. Their use has eliminated the formation of insoluble calcium and magnesium soaps on the work during the water rinse and in consequence there is no formation of fatty acids in the acid dip. In addition, they have increased the efficiency and free rinsing characteristics of the cleaner. The selection of a wetting agent for this application is governed by its stability at high pH, its tolerance to calcium and magnesium hardness, and its free rinsing properties.

Some of the wetting agents if stable at low pH may be used to advantage in muriatic and sulphuric acid pickling solutions. By reducing the surface tension, they allow the acid to completely wet the surface of the metal and allow a uniform pickling action. In addition, they reduce dragout losses to a minimum by decreasing the thickness of the acid film on work as it is removed from the pickling solution. The emulsifiable characteristics of the material assist in the removal of traces of oil and grease not completely removed by the cleaning process and also prevent the formation of insoluble fatty acids which normally float on the surface of the solution and adhere to the metal.

1. F. J. Antwerpen, J. Ind. Eng. Chem. vol. 31, p. 66, 1939.
2. B. G. Wilkes and J. N. Wickert, J. Ind. Eng. Chem. vol. 29, p. 1234, 1937.

New Equipment for Treating Metal Parts in Bulk



At the annual meeting of the American Electroplaters' Society, held this year in Dayton, Ohio, Dr. Gustaf Soderberg of The Udylite Corporation, gave an illustrated talk on new equipment for treating parts in bulk. Illustrated above is the "chute into chute" type of automatic equipment for side-transferring of work from one treating tank to another, which was one of the many types of equipment shown.

Alkalis For Metal Cleaning

By Dr. T. K. Cleveland

Chief Chemist,
Philadelphia Quartz Co. of Cal. Ltd.

This paper was presented at the 1940 annual meeting of the Los Angeles Branch of the A.E.S. and is reprinted from the June, 1940 issue of the Monthly Review. Various features of alkalis that influence their use and efficacy as metal cleaners are considered at length. These include: active alkali, pH, conductivity, wetting power and deflocculation.—Ed.

TODAY'S most improved type of metal cleaning solution will contain three basic elements:

1. An alkali
2. A substance that reduces the surface tension, and
3. A softening agent of high efficiency.

These are named in what is believed to be the order of their importance.

The Alkali

Probably the majority of metal cleaners now being used consist only of an alkali or a combination of several alkalis. In a large number of cases, they are sufficient for the purpose, since they are able to precipitate hardness in a degree satisfactory to the cleaning conditions prevailing. Also, the alkali is generally strong enough to react with any free fatty acids present, to form soaps which in turn serve as wetting agents, important aids to cleaning. Such characteristics combined with the ability to neutralize acid dirt and maintain simultaneously the pH of the cleaning solution at the necessary level for effective cleaning as well as exerting specific protective reactions toward soft metals, just about place certain commercial alkalis under the classification of all purpose metal cleansers.

Dr. T. K. Cleveland

Total and Active Na_2O Content of Various Alkalis

The active Na_2O content is an important factor when estimating the value of any particular alkali as a cleaner. This property is determined by titration with standard acid to a phenolphthalein endpoint. Total Na_2O is the result obtained when the titration is done with methyl orange indicator. The difference between the total and the active Na_2O is termed inactive, to denote its uselessness for cleaning purposes. It is generally recognized that alkali solutions show practically no cleaning effects below a pH of 8.3. Hence that portion of the total Na_2O available above a pH of 8.3 is conventionally termed active Na_2O. Some individuals are accustomed to think in terms of caustic soda (NaOH) equivalent and they may readily change Na_2O into NaOH by using the factor 1.316.

Figure 1 graphically compares the total, active and inactive Na_2O contents of the better known commercial alkalis. Table 1 lists the numerical values for active and total Na_2O.

TABLE I

Alkali	Active Na_2O	Total Na_2O
Caustic soda (NaOH)	75.5	76.0
50 Caustic—50 metasilicate, granular	51.5	52.6
Sodium sesquisilicate ($3Na_2O{\cdot}2SiO_2{\cdot}11H_2O$)	36.5	37.9
Sodium metasilicate ($Na_2O{\cdot}SiO_2{\cdot}5H_2O$)	28.0	29.2
"BW" silicate of soda ($Na_2O{\cdot}1.6{\cdot}SiO_2{\cdot}8H_2O$)	18.7	19.7
Trisodium phosphate ($Na_3PO_4{\cdot}12H_2O$)	10.0	18.0
Sodium carbonate (Na_2CO_3)	29.0	58.0
Tetrasodium pyrophosphate ($Na_4P_2O_7$)	8.1	23.3
Borax ($Na_2B_4O_7{\cdot}10H_2O$)	8.4	16.3

Several inferences regarding the cleaning ability of a particular alkali solution may be drawn on the basis of its active Na_2O content. First of all, part of this Na_2O will be consumed in the neutralization of acidic constituents in the dirt. Frequently these are fatty acids and are neutralized (saponified) to form soaps. Again, the active Na_2O content is closely associated with the pH of the solution in that generally the greater the Na_2O the higher will be the pH. Thirdly the conductivity of the solution may be readily correlated with the active Na_2O content.

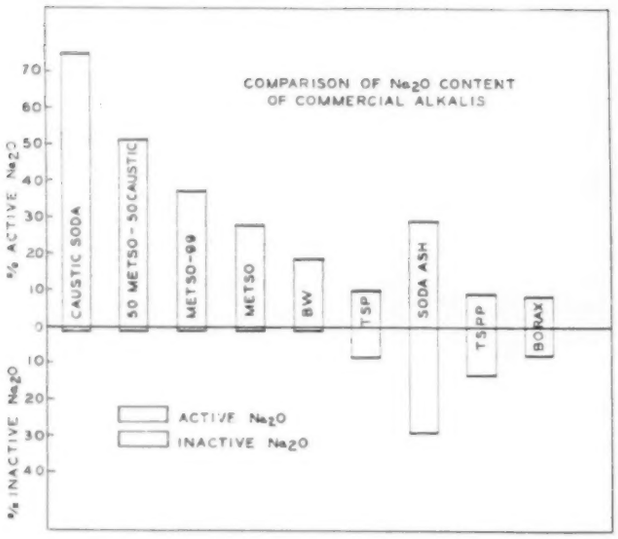


Figure 1. Comparison of active and inactive sodium oxide contents of commercial alkalis.

pH of Alkaline Solutions

A good analogy for active Na_2O and pH is to compare them to amperes and volts respectively. The pH of a solution is a measure of its activity or driving force, in other words, its power to clean. The tougher the cleaning job, the higher the pH necessary. It is possible to have solutions that are relatively high in active Na_2O yet the pH will be so low, they are useless as a cleaner. Thus a 10% solution of borax would contain 0.8% active Na_2O and have a pH of only 9.3. On the other hand, a 3% solution of sodium metasilicate would show the same active Na_2O content (0.8%) but with a pH of 12.9. This latter solution is more efficient as a cleaner in that the higher pH (similar to voltage) can more readily overcome the resistance of dirt to leaving the surface being cleaned.

Figure 2 gives comparative pH data for technical grades of the principal alkalis.

Conductivity of Alkaline Solutions

Where cleaning is done electrolytically, that is, with the aid of electric current, the conductivity of the cleaning solution is quite important. The pH of an alkaline solution can be used as a rough indication of its relative conductivity. This relation is not strictly proportional in all instances since ions other than the hydroxyl also carry a portion of the electric current.

The increasing need for more rapid cleaning necessitated by the development of automatic and continuous plating equipment has led to the adoption of cleaning solutions of higher conductivity. These are obtained most economically by using alkalis that produce a rise in pH proportionate to the increase in Na_2O content of the solution. Sodium metasilicate and all combinations of it with caustic soda show this characteristic.

In order to acquire some information regarding the conductivity of solutions of various alkalis, a laboratory experiment unit was set up. This consisted of two iron electrodes 3 inches x 3.5 inches made from cold-rolled sheet. The surfaces were cleaned off by sandblasting. A standard 6-volt storage battery served as current source and the current flow was measured by an ammeter with the ranges 0 to 1 and 0 to 10 amperes. The electrodes, placed 3.5 inches apart, were immersed in the solution of alkali contained in a beaker set over an electric hot plate. Readings of current flow were begun at a temperature 20°C. (68°F.) and continued at 20 degree intervals up to boiling (100°C.). A concentration of 3% (4 oz. per gallon) was used for each alkali and the conductivity of its solutions calculated to the basis of amperes per square foot of electrode area per linear foot of distance between the electrodes. The potential drop in this series of tests was 6 volts. Figure 3 illustrates the conductivity data plotted graphically.

Another interesting comparison is the increase in conductivity for a temperature rise from 20°C. to 100°C. These comparisons are given in Table II.

TABLE II

COMPARISON OF CONDUCTIVITIES OF ALKALI SOLUTIONS AT 20°C. and 100°C.

Alkali	Conductivity 20°C.	Conductivity 100°C.	Factor of Increase
Borax	2.12	7.55	3.56
"BW" Silicate			3.38
TSPP	3.86	12.50	3.26
TSP	3.76	15.65	4.16
Soda Ash	7.05	23.20	3.29
Metasilicate, Granular	6.58	20.40	3.14
Metso, 99	10.10	27.30	2.70
50 Metasilicate—50 Caustic	16.20	41.10	2.54
Caustic Soda	26.30	64.90	2.46

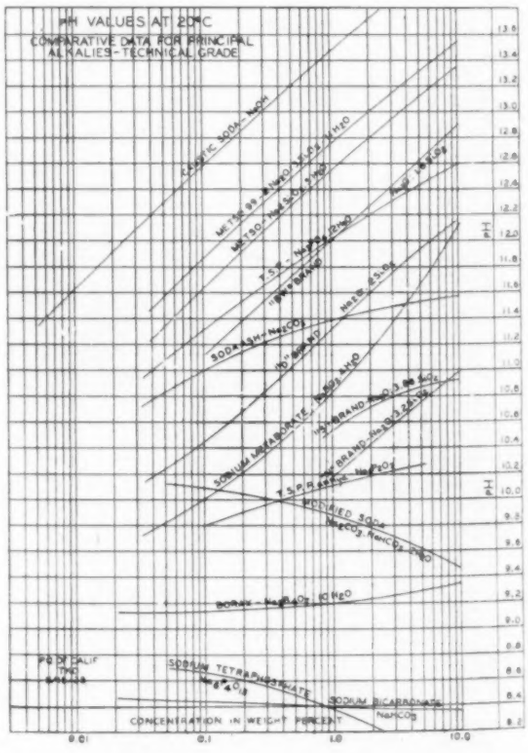


Figure 2. Comparative pH values of commercial alkalis at 20°C.

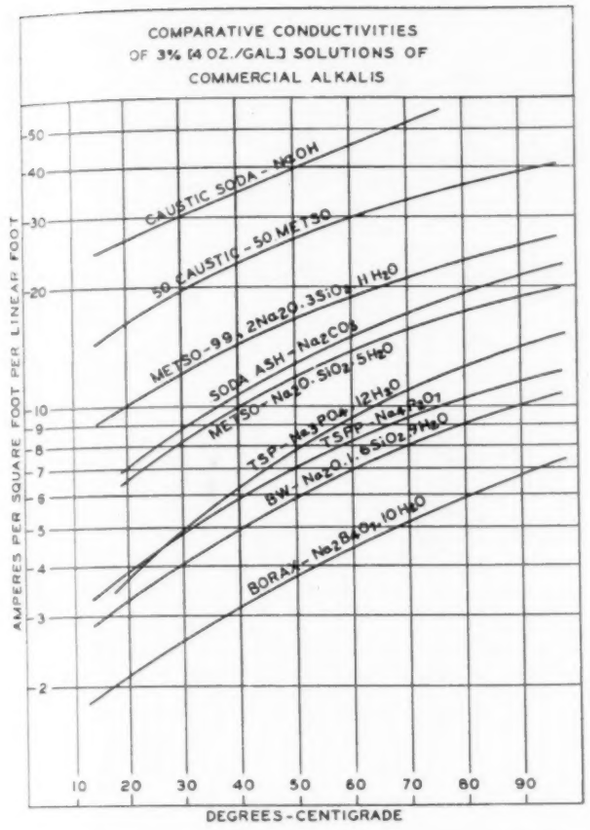

COMPARATIVE CONDUCTIVITIES
OF 3% [4 OZ./GAL.] SOLUTIONS OF
COMMERCIAL ALKALIS
AMPERES PER SQUARE FOOT PER LINEAR FOOT
DEGREES - CENTIGRADE
CAUSTIC SODA - NaOH
50 CAUSTIC - 50 METSO
METSO - 99 2Na2O . 3SiO2 . 11 H2O
SODA ASH - Na2CO3
METSO - Na2O . SiO2 / 5H2O
TSP - Na3PO4 / 12H2O
TSPP - Na4P2O7
BW - Na2O . 1.65SiO2 . 7H2O
BORAX - Na2B4O7 . 10H2O

Figure 3. Relative conductivities of commercial alkalis at concentration of 4 oz./gal.

Preferential Wetting of Surfaces

Practical cleaning experience has furnished evidence that solutions of various alkalis differ in a number of other respects. Thus it can be readily demonstrated that solutions of sodium metasilicate will leave a glass surface perfectly free from grease or oil films. Absence of standing droplets on the rinsed surface is accepted as proof. Solutions of soda ash and caustic soda are incapable of doing this under similar conditions of testing. J. M. Cosgrove[1] has developed a laboratory demonstration which shows that metasilicate solutions also possess superior preferential wetting power for metal surfaces.

Emulsification

The ability of alkali cleaning solutions to emulsify oils and greases frequently can be correlated with the pH of the solution and whether or not a reduction in surface tension has occurred. A permanent emulsion is undesirable in soaking and electrocleaning tanks since such would greatly shorten the useful life of the bath. The cleaning bath when in operation probably should bring about spontaneous emulsification of the oils which action removes them from the surface, disperses them throughout the solution and prevents their sticking to the cleaned work as it is removed from the bath. In a report read before the Dayton Branch of the A.E.S., Charles C. Conley credits metasilicate solutions with the ability to stabilize emulsified greases.

Suspension of Dirt—Insurance against Redeposition

Particles of solid dirt usually settle to the bottom of the cleaner tank during quiescent periods. However, during operating hours these fine pieces of metal dust and debris from polishing grains remain suspended in the cleaning solution. It is essential that they continue in this state and not redeposit on the surface of the work prior to its removal from the bath. Sodium metasilicate solutions rank high in their ability to suspend solid dirt and to prevent its redeposition upon cleaned surfaces. This latter property is particularly important in the laundering of fabrics.

Effect of Alkaline Solutions upon Nonferrous Metals

Metals such as zinc, tin, aluminum, the so-called soft metals, are readily attacked by solutions of practically every alkali except the silicates. These latter seem to have some specific protective action upon such metals which prevents them from dissolving away in the alkaline solution. For this reason, sodium metasilicate solutions are especially suited to the cleaning of diecastings. Conley also observed that the addition of sodium metasilicate to the electrocleaning solution greatly reduced the tarnishing of buffed copper.

TABLE III

EFFECT OF ALKALINE CLEANING SOLUTIONS UPON TIN

Concentration ..... 0.32 oz. per gallon
Temperature ..... 180°F.
Time ..... One Hour

Alkali	pH of Solution	Weight Loss in Grams per Square Meter
Modified Soda $Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$	10.0	0.47
Soda Ash Na_2CO_3	11.2	0.79
TSP $Na_3PO_4 12H_2O$	11.6	0.92
Metasilicate Granular $Na_2SiO_3 \cdot 5H_2O$	12.0	0.14

TABLE IV

EFFECT OF ALKALINE CLEANING SOLUTIONS UPON ALUMINUM

Concentration ..... 1.3 oz. per gallon
Temperature ..... 212°F. (Boiling)
Time ..... One Hour

Alkali	pH of Solution	Weight Loss in Grams per Square Meter
Soda Ash Na_2CO_3	11.4	31.60
TSP $Na_3PO_4 \cdot 12H_2O$	12.0	21.90
Metasilicate Granular $Na_2SiO_3 \cdot 5H_2O$	12.6	0.22
Caustic Soda NaOH	13.5	129.00

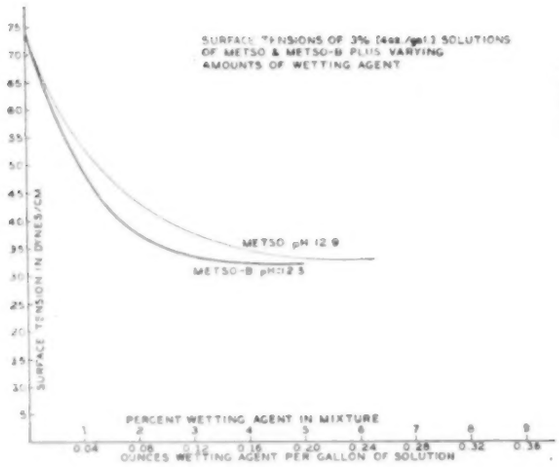

SURFACE TENSIONS OF 3% (4oz./gal.) SOLUTIONS OF METSO & METSO-B PLUS VARYING AMOUNTS OF WETTING AGENT
METSO pH 12.9
METSO-B pH12.5
SURFACE TENSION IN DYNES/CM
PERCENT WETTING AGENT IN MIXTURE
OUNCES WETTING AGENT PER GALLON OF SOLUTION

Figure 4. (Left) Surface tensions of 3% solutions of metasilicate with wetting agent.

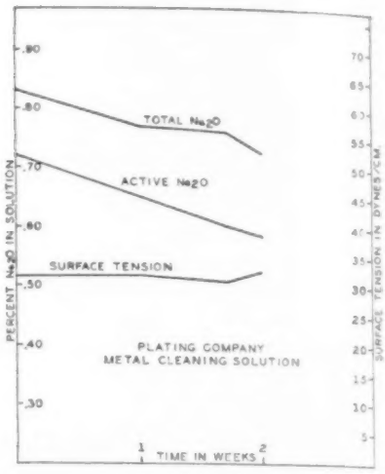


Figure 5. (Right) Progress of a cleaning bath from its beginning to its discard.

The Wetting Agent

Practically any alkaline solution will show improved cleaning ability if it contains a so-called wetting agent which acts to lower the surface tension of the solution. Water has a surface tension of about 73 dynes per centimeter and all alkaline solutions are approximately the same or perhaps even one to two dynes higher. On the other hand, a solution of wetting agent—soap being a well-known one—will show a surface tension of 30 dynes or less in a one-tenth per cent concentration. The chief disadvantage of the soap is that it can be precipitated by calcium and magnesium salts, the usual forms of hardness found in water. Because of this difficulty, new types of wetting agent have been developed which do not seem to be adversely affected by the hardness. Consequently, they will maintain in such waters a lower surface tension than soap which is quickly put out of action.

Electroplaters have always been aware of the value of reduced surface tension in their cleaning solutions. In one sense, they could not help it, since practically all polishing and buffing compounds contain saponifiable matter which immediately reacts with the alkali in the cleaner to form soap. It used to be the practice of platers to start off a fresh bath of cleaner by throwing into it a bucketful of the one discarded. Cleaners were usually straight alkali mixtures and the "bucket" represented the addition of a wetting agent (soap formed in the old bath). The benefits of a wetting agent are particularly one of better rinsing although they no doubt aid materially in the wetting of the dirt and its separation from the work.

Invariably the presence of a wetting agent is marked by a foam or suds on the surface of the bath when agitated either mechanically or by the bubbles of gas from the cathode and anode. In some cleaning setups an excess of foam may be objectionable and will need to be controlled. High pH's and the presence of mineral oil on the surface tend to suppress foam, the volume of which is normally proportional to the amount the surface tension has been reduced. A deliberate reduction in the quantity of wetting agent will tend to regulate the foam yet not appreciably affect the rinsing properties.

Figure 4 shows the effect obtained when increasing percentages of one of the newer forms of wetting agent are mixed with a standard alkali such as sodium metasilicate or with a proprietary mixture. Observe that nothing is gained by increasing the wetting agent beyond a certain critical concentration.

Figure 5 graphically illustrates an interesting story. It represents the progress of an electrocleaning bath from its beginning to its discard. One of the newer type of wetting agents was used. Observe that the bath suffered a steady decrease in active alkali and finally reached the point where its cleaning activity ceased to be effective despite the maintenance of the surface tension at what is probably its maximum point of efficiency.

It should be mentioned that not all the newer type wetting agents are equally suited for solutions of high alkalinity or pH. Some tend to be salted out or precipitated and will not be recommended by the manufacturer for such purposes. However, a considerable number are satisfactory and can be determined either through recommendation or by test.

Softening Agents

When discussing the properties of alkalis it would have been entirely appropriate to refer to their water softening powers. All of them possess in varying degrees the ability to precipitate hardness but on the other hand they are unable to protect the soaps completely. In solutions of relatively high pH (12 to 14), the preponderance of alkali usually enables the cleaner to operate successfully, but where the alkalinities are lower (10 to 12), good rinsing and scale-free equipment can only be obtained by the use of a more effective softening agent in conjunction with a wetting agent.

Tetrasodium pyrophosphate shows a pronounced improvement in the cleaning operations when used along with other alkalis in relatively hard waters. However, certain types of polymerized phosphates exhibit a still more remarkable softening action through their ability to so tie up the calcium that it cannot react with soaps. In some instances, these phosphates are even able to decompose the calcium soaps already formed.

Considerable experimental research and actual field application have demonstrated that the judicious use of such softening agents will result in cleaner, freer rinsing polished surfaces such as those of china, glass and silver. Washing equipment tends to remain free from scale and other deposits. Their continued and increasing use probably depends upon an economic factor embracing the cost of the material in relation to the service performed.

On Finishing Foremanship

By Paul C. Kramarcik

Syracuse, N. Y.

Paul C. Kramarcik

This article gives the viewpoints of a practical finishing room foreman on troubles due to faulty leadership and manufacturing. The Editor does not necessarily agree with all of the conclusions of the author, but his article contains many worth while suggestions, particularly as to policy which go to make a successful finishing room.—Ed.

Finishing Foreman vs. Engineer

As the years pass by, more responsibility is put on us on account of changes in manufacturing methods and increase in variety of products. Years ago, one had only the plating room department to supervise and the rest of the plant looked up to the plating foreman as a smart man or expert. If fairly good work was produced, you were respected as a man of ability, but now another factor is encountered, namely, interference from the technical men lacking experience. Remember, chemistry is now taught in our high schools and colleges and the students come out waving a diploma. Many mechanical engineers claim to know all about chemistry and have tried to tell us all about it. They read articles in magazines which, to say the least, are often misleading and do not fit your conditions at all. For instance: they suggest replacing copper plating with copper dipping; also to replace zinc and cadmium plating with dipping processes. You do not get a cadmium coating, but what I would call, a tin coating, which is all right for small things such as screws, bolts, nuts, etc. It might do on hooks, eyes and safety pins, but I cannot see where the process is any cheaper than plating them in a plating barrel, if you have one.

This is not the worst of it: the manager is surrounded with mechanical engineers telling him how to save expense (on paper only). Just the same as the methods man going around making an easy living at the expense of the practical man. Note the change now to "Methods Man". You all know the old title, but it has worn out. It does not go any more. I won't say that these conditions exist universally, but in a good many instances, and there is very little done regarding improvements in the finishing line. It does not seem to matter how much it costs for other operations in making an article, but it should cost only a fraction for finishing and many times you have to make good for previous errors from other departments.

Good Plant Supervision Needed

The supervision in a plant should see to it that every operation is performed correctly before going on through. Defective work will happen but should not be allowed to be repeated or to continue. If extra work is supposed to be performed in another department through neglect of others, credit should be given to those who make the correction. This should include polishing, plating and organic finishing. Much more responsibility is piled on us than years ago. We are expected to be not only electroplaters but also metallurgists.

On Polishing

Proper polishing is a matter of the past. As our friend, Ernest Lamoureux said in the March issue of METAL INDUSTRY about polishing: "You use canvas wheels instead of leather covered, bullneck or seahorse". A canvas wheel does not polish but drags the metal and takes a long time to put a good old polished surface on it.

Years ago when work was delivered to the plating department, it was polished, not scratched and the deposit you put on, stayed on. Now if we put on three thousandths, two thousandths are buffed off. Go into the buffing room in some places and you will have a hard time to see the men at the wheel; the room is full of blue smoke, coming from the heat of the buffing wheels and greasy substances from the compositions. I call this "pennywise and dollar foolish".

Plant Troubles

In my entire career I have had many sorrows going

around in different plants and noticing the condition of plating rooms. It would take too long to go into that, but I will give you a short outline: Overloaded generators; filthy tanks; a foot or over of sediment in the tanks; no metal, just acid and water. It seems to me that some platers do not know that solutions should be checked and replenished when necessary.

I recall one instance where the man in charge was laboring under the illusion that after a solution is once made, it should continue by just adding anodes and water. How is it they obtain a job and under what influence do they hold the job? How much money is lost when the man runs up against it and runs the solution into the sewer. I know of one case where the plater ran a bronze solution into the sewer with a hose and a polisher thought it was water running from the faucet and took a drink. Well, you know what happened to him and the plater. This happened in the Middle West and the information came to me first-hand from one whom I can vouch as to his honesty and integrity. It has been my grief to witness such instances.

Again at times I have received a lot of kick out of some of the various suggestions and recommendations made to me by engineers. *I don't mean chemical engineers.* For instance, trying to explain to them why you cannot plate silver in a nickel tank, or why you cannot plate white nickel in the same tank that you have for black nickel, just by transferring the solutions into containers and then reversing the operation (splendid idea!). I have come across some instances where it would have been cheaper to have dumped every solution in the place and then renew them. The reason I did not do it was because I like to nurse a sick child back to health. Again it gives me a lot of satisfaction and experience and if I had dumped it, it would be said "he can only work his own formulae", and that is where you lose your prestige. It is very difficult in many plants to get any improvements in the plating departments. Some are working with very unreliable generators and others just whizzing along like an old Henry Ford model T. A generator should be checked and looked after, as well as solutions, at least once a week.

Organic Finishing

Now, Mr. Plater, comes more responsibility: it is Organic Finishing. A lot of manufacturers have expanded. You always had the lacquer department to look after, why cannot you look after a little more to save overhead? Of course, at first it does not look so big but it grows. You start off on a small scale and gradually increase. The first thing you know you have something to contend with. More so if you are not familiar with it, but of course, you must learn. If you are intelligent enough for polishing and plating, why cannot you paint? It is easy—why anyone can paint a house, they will tell you. You will get the promise of the proper equipment and a spray room, but getting it after you show little results is another question. The promise is forgotten. You are doing fine—just continue. First off, you have only plain colors. If you have a baking oven, you will have less trouble, but you have to use quick drying lacquer base material and then you will have your hands full on large work. For instance, four-foot wide, twelve to eighteen-foot long desks with a lot of cubby holes and panel work, all assembled. You will have to watch out for throw-backs. It takes a good man to prevent them. Above all, you should teach your man to have the spray gun in perfect condition and the head parts of the spray gun should often be renewed as they wear out and give a defective spray.

That is not all—your concern might make certain parts of the interior of the building and other concerns, others. You will have to match the colors. They might be baking material and you are using quick air dry. That is where you have to use your head to match an old sample plate. You might match perfectly, but drop a trifle on your plate and you will find it dries darker, but to make sure, put some in the gun and spray, then you will find a big difference in the shade. It will take some time to get the hang of it.

The hardest matching to do is graining. Many companies use a transfer plate method, which is not as difficult as to match hand-graining, where you have three shades and only two of your transfer. When you get into this eventually, you will come into contact with some unscrupulous salesmen who will urge your concern to buy their materials, stating they are better than you have been using for years, etc. They are all out to make a living and you cannot blame them.

When a certain manufacturer went into graining, a salesman called on them and he contacted one of the officials and certainly worked it to the limit. A live wire salesman he was. Before going any further, I would like to say these goods are not advertised in METAL FINISHING. Well they looked the situation over and made arrangements to supply equipment and material, telling the concern about the cost. Just in order to make the sale, they made the cost very low—so much so, it was ridiculous. I will try to give an illustration of one unit that is a two-man job. They had the cost of forty-five cents (45c) for labor just for the graining alone. They sent an expert to show the processes. Now this is where the joke comes in: it was necessary that the expert have a man assigned to him to learn and assist him on that unit. It took him four and a half hours. Now figure four and a half hours for two men, making nine hours labor. How does forty-five cents cover nine hours of labor? I will admit it was a very difficult job to go over the humps and hollows. The foreman disputed the cost right on the spot but was told to wait and see. But when he proved that the cost was out of proportion, the salesman recommended a sort of a hydraulic equipment, but it never reached that point. The foreman got the cost of eighty cents per unit. That is not all, the firm got an awful hornswaggling. They wanted the firm to change over to using all of their materials for spraying, etc. For instance, lacquer at 25c per gallon cheaper. Where the foreman used three parts of thinner to one part of lacquer with his previous material, he could only use one part of lacquer and one part of thinner. After awhile, the lacquer became so thin that he could not use any thinner. Now, figure out twenty-five cents per gallon less and use no thinner. The official who made that deal is no longer with them nor is the concern selling any more of their material.

They went out in bad graces. The reason is to be explained with the letter "G". G .....

Buying Supplies

In buying supplies, I do not think it is more than fair for the foreman to be consulted. It is he who has to contend with his problems. I mean the foremen of every department. If he is capable, he will give you his good judgment. Should he be dishonest, then they should get rid of him. I think it would pay to take department heads into a little more consideration on factory problems.

In the early twenties I happened to come across quite a joke. I took a position with an eastern company. They were a very nice concern. One member of the firm acting as buyer, bought all chemicals from a particular friend. I had a hunch there was some trimming being done. I finally worked my way into the confidence of the gentleman and made a change in buffs. (If the salesman reads it, he will get a big laugh out of it). He is still alive. He remarked: "What in h . . . , is this all I am going to sell—just buffs? I told him to hold his horses, took him into the office and explained the matter to Mr. A and asked him if he could buy something else besides buffs. He was very agreeable and asked me what I would need. I told him a barrel of ammonium chloride He asked the price. The salesman said twelve or thirteen cents. It was not above thirteen cents. Then Mr. A asked the bookkeeper to look up the records as to previous price paid and the report came back, twenty-four cents—some difference per pound. I thought the old gentleman would drop over from heart failure. Did he utter some swear words—and he was not in the habit of swearing either—he was a good church man. Well, he says, "that shows you that you can't always trust your friends. We served in the War side by side. It is a wonder he did not stab me in the back". After that, there were no more sales made without me. This should be good advice to all foremen. *Do not let yourself be bribed if you think anything of your reputation.* The foreman that had to contend with that graining outfit had something offered to him in order to endorse it, but he is not that kind. His reputation is too good to be sold in that way.

Another big mistake a foreman makes is hiring friends, acquaintances or relatives. Keep your relatives out of your department—also your friends. It never works out well.

Now a word about the condition in spray rooms: I find them very bad in some places: very much neglected. So long as you get the job out barely passable, no improvements will be made.

Above all, the spraying room should be clean—good lights and good ventilation. Your lacquer finishing and graining should not be done in the same room where you spray bronze, nor cleaning, sanding or heavy dusting. All parts should be properly cleaned. Sheet metal should be cleaned before assembling. Especially where they are spot-welded because you will not get the grease and oil out of the crevices after assembling. This has reference to cabinets, pedestals, desks, etc. Of course, you will have to clean them before priming, by hand.

Good Supervision Requires Practical Knowledge

All department heads should have the ability of instructing the men and use diplomacy. Do not tell a man how to do it unless you are able to show them yourself as to how the operation is done. What became of the superintendent that used to walk around the plant for practical knowledge, with coat off and in shirt sleeves, to see what is going on in the different departments and to correct errors? By the week-end, he won't care much about going to play golf for exercise. He will have enough exercise right there, and will find a way of getting good production throughout the plant and a reputation for himself.

I knew a case where a man secured a position of superintendent through the I.C.S.—he never worked in a manufacturing plant before. He used to be a salesman. Took a course from I.C.S. and got the position after graduating. He was not a bad sort of a fellow—only very seldom left his office. Surrounded himself with a few lieutenants to look after the plant and make reports and suggestions to him. That was a very bad idea, to show them how little he knew about manufacturing. The consequence of it was they undermined him by giving false reports and he lost out. A manufacturing concern should be more rigid in selecting a superintendent. Should make sure he is a practical man and understands all operations in order to make corrections and not depend solely on his lieutenants.

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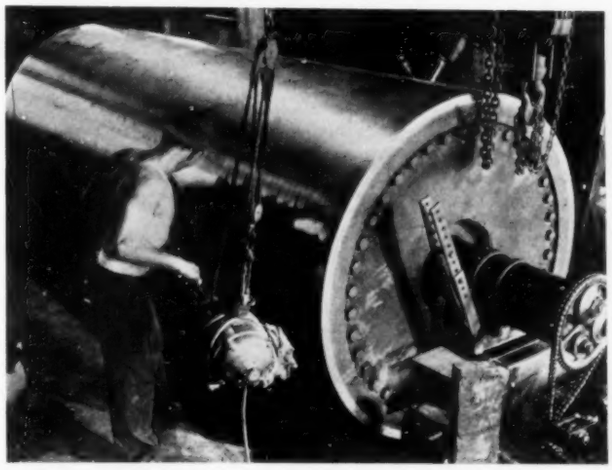
GIANT CHROMIUM PLATED CYLINDER



Illustrated above is what is believed to be one of the largest chromium plating jobs in the Middle West, which was just finished by the Chrome Plating Co. of Milwaukee, for the Marathon Chemical Co., Rothschild, Wisc. About 0.009″ of chromium was applied and this plating is expected to last at least a year. The cylinder is used as a drier in paper making.

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The Reaction of Zinc and Iron In Hot-Dip Galvanizing

By Dr. Ing. Heinz Bablik

This outstanding paper on hot-galvanizing was prepared for the British publication, Iron and Steel, before the war and is herewith reprinted through the courtesy of Iron and Steel, the paper appearing in the October and November, 1939 issues. Dr. Bablik is well known for his book on hot-galvanizing and for numerous technical papers. This article is profusely illustrated with excellent photomicrographs to clarify the technical exposition. The zones of iron-zinc alloys and the effects of temperature of galvanizing and the geometry of the sub-strate on these zones are discussed. The effects of aluminum and tin are also considered.—Ed.

THE reaction that takes place in a hot galvanizing bath during the dipping of iron into molten zinc is of the greatest interest in view of the quality of the coating produced. Many factors are involved in the control of the layers of zinc-iron alloys that are built up during this process. On the one hand there is the influence of the intensity of the reaction, that means the quantity and quality of heat that is taken by this reaction, measured by the dipping time and the temperature of the zinc bath. On the other hand there are the qualities of both the reactionary components. This quality is not only determined by the chemical composition but also by some other physical qualities, as for instance, the condition of the surface of the iron in respect to its form and its smoothness, and other factors. With regard to the chemical composition, some of the elements have a far greater influence on the coating than others. Furthermore, the influence is different according to the structure of the element itself. Therefore, it makes a great difference if carbon is present as graphite or as cementite or as pearlite.

In order to prevent the description from becoming too complicated first only the two components iron and zinc will be taken into consideration. What is seen in a microsection through an ordinary hot-galvanized coating is the result of the diffusion that takes place between iron and zinc and the chemical reaction that occurs in consequence of this diffusion and ends in forming different phases of the binary iron-zinc alloys.

The general opinion is that when a solid metal is dipped into a molten one, all the phases which the equilibrium diagram of these two metals shows are formed. Hence it seems to be useful to study the latest equilibrium diagram of iron-zinc alloys. We may expect to be able to find all the phases of the equilibrium diagram repeated in the hot-galvanized coating. The investigation of the iron-zinc diagram is a complicated matter, and for that reason this diagram is frequently amended. It may

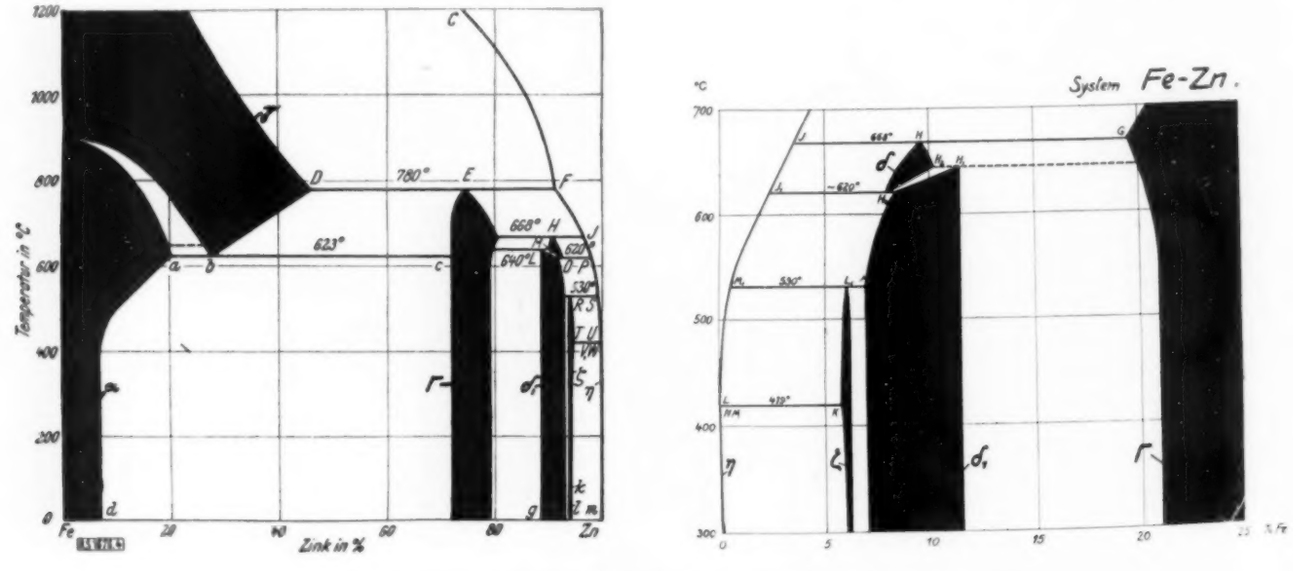


Fig. 1. Equilibrium diagram of zinc-iron binary alloys. By J. Schramm.

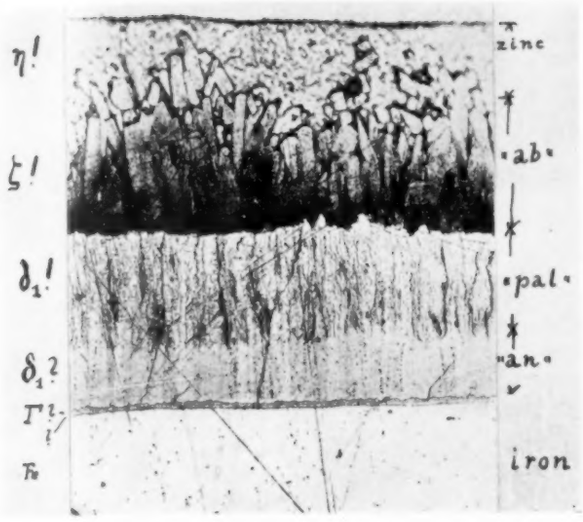


Fig. 2. Galvanized coating using electrolytic zinc. Dipping time: 1 hour. Dipping temperature: 475°C. 350 X.

be therefore that the diagram published by J. Schramm a short time ago is not yet completely accurate. This may be said because it is not possible to explain unequivocally, the structure of hot-galvanized coating from that diagram.

In the equilibrium diagram (Fig. 1) the following homogeneous phases are shown, reading from the zinc to the iron side:

η : solid solution of iron in zinc. The maximum iron content is said to be 0.03 per cent Fe. The crystal structure is the same as that of zinc, a hexagonal structure with axial ratio = 1.856.

ζ : a phase of which the concentration in iron is between 6.0 and 6.2 per cent Fe. The peritectic reaction

$$\delta_1 + \text{Liquidus} = \zeta$$

is noteworthy. It seems that the velocity of this reaction is very low. The temperature at which this phase disappears does not appear to be quite definitely established. The crystal structure has been found by Halla and Weil to be monoclinic. The specific gravity is 7.18. The typical appearance of such crystals is given by Fig. 2. It is a microsection of a hard dross of a galvanizing bath with the addition of some aluminum, in accordance with continental sheet galvanizing practice.

δ_1 : a phase with a wider range from 6.2-11.5 per cent Fe. The crystal structure of this phase has been determined by Halla and Gotzl as a hexagonal one of the type C^4_6v = C6mc or D^4_6h = C6/mmc. The unit cell has the distance a : 12.8Ac : 57.6A and 555 ± 8 atoms; the form of the crystals is hexagonal-bipyramidal a combination of (0111) and (0221) as is shown in Fig. 2.

T : is to be found between 20 and 27 per cent Fe. Ekman has determined that the crystal structure is the same as the so-called "γ brass" structure.

Great difficulty arises in the investigation of this diagram from the range of this iron content upward, and it is probable that some amendment may be expected in this range later on.

Moreover, it is not easy to correlate the different layers as they are to be seen in a microsection, with the phases of the equilibrium diagram. In order to minimize the difficulties, names have therefore been given first of all to every layer which could quite clearly be defined in such a microsection. In Fig. 2 are marked the different layers and the names (these are abbreviations of names that signify the appearance of the layer) given them. Up to the present, it is thought, the co-ordination of the different phases of the equilibrium diagram is as marked in this microsection. An exclamation mark (!) indicates what seems to be already quite correct and a note of interrogation (?) what perhaps is still to be verified. Unfortunately, at the moment practically nothing is known about the velocity of the diffusion of the two components, and especially how this diffusion occurs in the different phases. It must be borne in mind that, as a general rule, a layer (consisting of a certain phase) grows by the penetration (through the opposite boundaries of this layer) of more material than that which is lost. It can be said, therefore, that the building up of a phase is a function of the velocities of the diffusion in the neighboring phases. Exact figures in respect of the relative velocities of the diffusion of iron and zinc have not yet been obtained. The conditions are complicated as the one constituent is initially molten and the other one solid; that is, at first, the solid iron becomes dissolved by molten zinc. Later on, as a solid reaction product is also formed, the further reaction must be considered from the point of view of the diffusion of the solid components. Now the conditions are further complicated, as it cannot be imagined how the velocities of the diffusion of the two elements are affected in the different phases which are—as stated above—different in their lattices. It is generally known that the configuration of the lattice is of marked influence, and in addition it must be remembered that the extent of the surface between the two phases has a noticeable influence.

Taking all these difficulties into consideration it seems best as yet to avoid giving a broad theory that would cover the whole ground, but to mention the exact facts as they can be stated and seen from the following microsections.

The influence of dipping time will first be noted. Figs. 3 and 4 show microsections through two hot-galvanized coatings with a very short dipping time. What we can

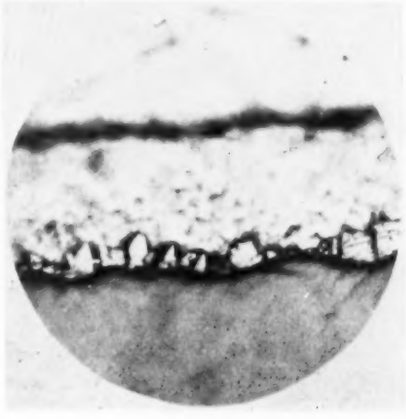


Fig. 3. Galvanized coating. Galvanized in a bath containing aluminum. Dipping time: a few seconds. 1300 X.

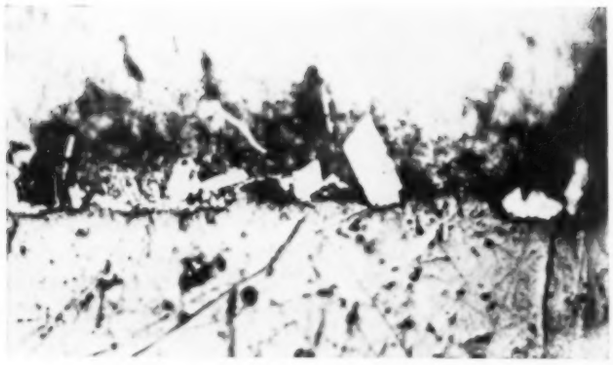


Fig. 4. Galvanized coating produced by the Sendzimir process. 1300 X.

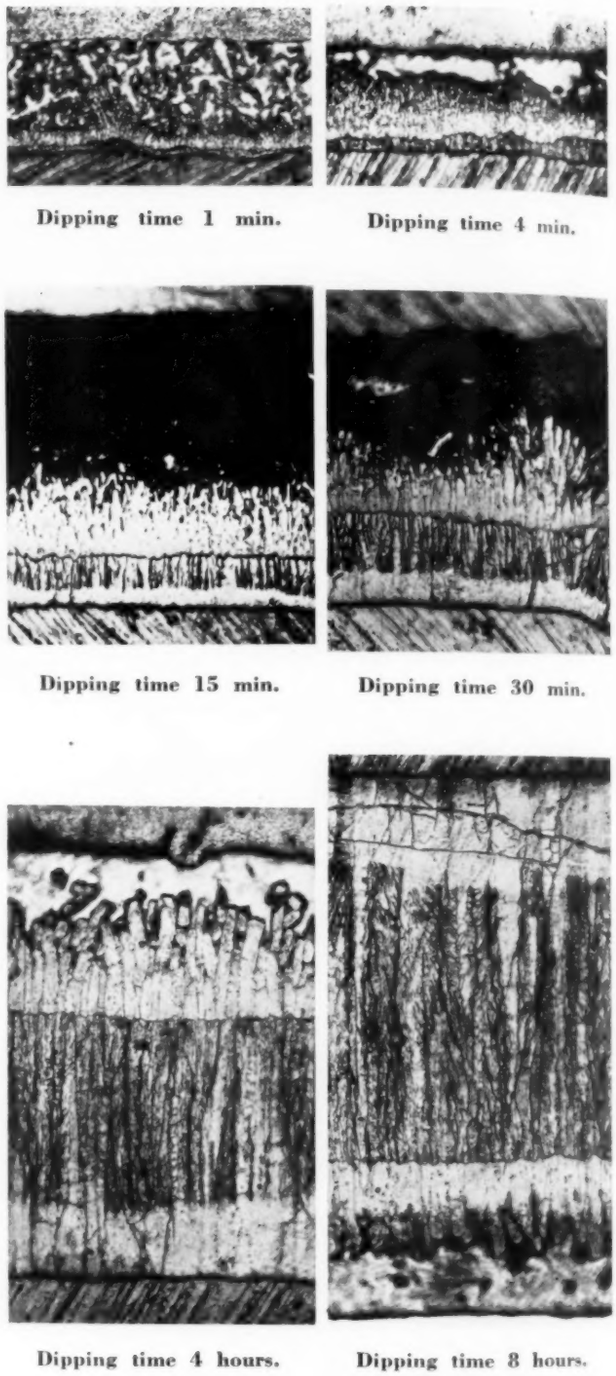
learn from this is that during such a short reaction time only one layer of well-established crystals is formed, crystals that have in some respect the appearance of the ζ phase. A still shorter reaction time may take place in the well known Sendzimir process. Here we see from Fig. 4 that the crystals formed as the product of a reaction in this short time belong to the ζ phase. In general in sheet galvanizing, dipping time will never be longer than 30 seconds, so that in general undefined alloy layers may be expected.

Quite a different picture is presented if the dipping time is increased. The series of microsections Fig. 5 show what may happen. At a dipping time even as short as one minute, quite clearly formed alloy layers can be seen, especially those called "pal" and "ab." With increasing dipping time, the layer "pal," particularly, grows larger than the others. With short dipping time unevenness is seen due to the influence of the pickling of the surface: this unevenness of the iron disappears with prolonged dipping on account of the dissolution of the iron. The stages in the building up of the layers can be clearly seen in Fig. 5 and also from Table A which shows in what relation to each other the different layers are formed. In the main layer "pal" increases.

TABLE A.

Dipping time in minutes	Relative thickness of the layer "an"	"pal"	"ab"
1	0	5	10
4	15	13	15
30	20	38	30
240	50	125	60
480	60	190	60

(To be continued in October issue.)



Dipping time 1 min. **Dipping time 4 min.**

Dipping time 15 min. **Dipping time 30 min.**

Dipping time 4 hours. **Dipping time 8 hours.**

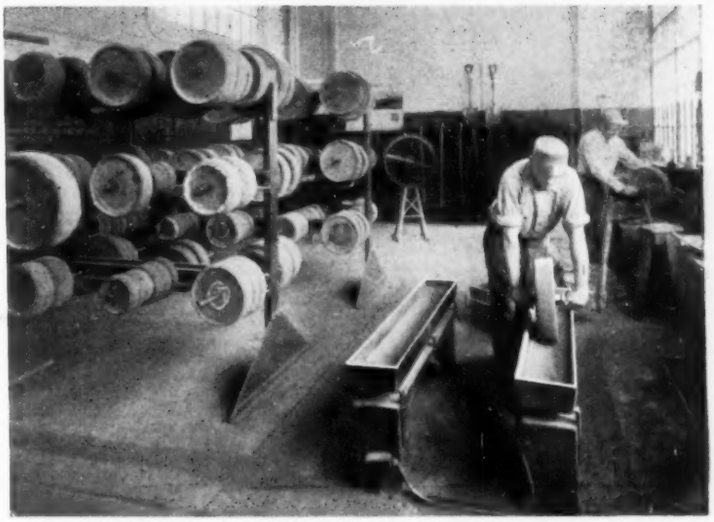
Fig. 5. Galvanized coatings showing influence of dipping times. Dipping temperature: 440° C. Bath: electrolytic zinc. 200 X.

Reducing the Cost of Polishing*

Some of the Factors that Influence the Economical Performance of Polishing Operations, and Detailed Directions for Obtaining the Best Results

By Henry R. Power

Chief Chemist,
The Carborundum Company,
Niagara Falls, N. Y.



Room equipped for the "setting up" of polishing wheels.

HIGH polishing costs are due not so much to incorrect methods of performing the actual operation as to the selection of the wrong polishing materials and to unsatisfactory practice in setting up the wheels. The two latter conditions account for most of the high costs in the setting-up room and low production and consequent high costs in the polishing room.

It is not uncommon to find shops in which the polishing cost is the largest item in the total cost of a metal product. Until recently, little study had been given to standardizing the materials used, the methods of setting up the wheels, or the methods of using the wheels. Yet, where this has been done, great economies have often resulted. In one case, the life of the wheels was increased 29 per cent, the cost of setting them up was reduced 40 per cent, and the total polishing cost was reduced 22 per cent.

It would take a good-sized book to describe in detail the best polishing procedure to use on each of the hundreds of different metals now finished by polishing, and such instructions would be subject to variation to meet specific shop conditions. It is, however, possible to give basic hints on selecting materials and setting up wheels which are universally applicable and will reduce total polishing costs in most shops. That is what this article is intended to accomplish.

Polishing involves the use of machines, wheels, glue, and abrasive. Most polishing machines are of the floor stand or bench type. However, for long runs, it pays to build automatic machines. Some very ingenious ones are in use in mass-production shops.

Polishing wheels are made of various fabrics and leathers, depending upon the material to be polished, the shape of the piece, the finish required, and whether the wheel will be used for roughing, dry fining, greasing, or finishing operations. The selection of the most effective and efficient wheel for a particular job calls for the advice of an engineer with wide polishing experience and, usually, careful tests under actual shop conditions. The following general considerations, however, will limit the number of wheels that need be tried out:

Wheels of woven cotton fabrics are most widely used. Metals to which they are well suited include iron, steel, brass, bronze, and aluminum.

For roughing cast iron and steel, and for dry fining on such parts as builders' hardware, canvas wheels are used.

Softer canvas wheels are used for polishing heavy castings of non-ferrous alloys, brass, copper, and aluminum. Quilted wheels of thin canvas are used for parts of irregular shape, such as stampings and castings.

Walrus-hide wheels give a fine finish, and are therefore used on firearms, cutlery, silverware and parts made of high-carbon steel where a very fine finish is often desired.

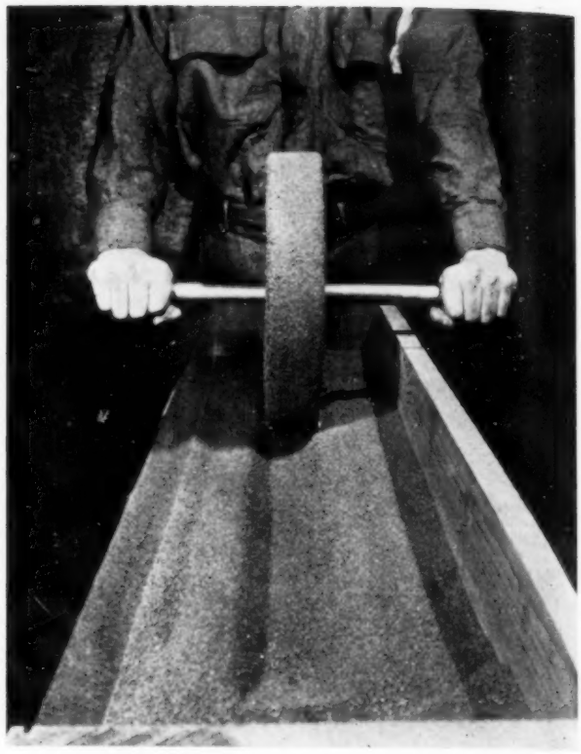
For very irregular shapes where fine finish is required, as in the automotive, airplane, and hardware industries, wheels of sheepskin or felt are used, due to the fact that their faces can readily be shaped to fit the surface.

Certain types of flat work, such as cutlery, call for a wheel with a thin cushion, backed by a solid core. Wooden wheels with a leather cover are suitable for such work.

Whichever type of wheel is selected, it is impregnated with abrasive, which is held to the wheel by glue. It is of great importance that the glue and abrasive be carefully selected for the particular operation, and applied in the proper manner. Only the best grade of hide glue should be used. It should be graded, by the viscosity test, at 115 millipoises or higher. Ground glue is easier to handle and more easily dissolved than flake glue.

* Reprinted from Machinery, March, 1940

Note how untreated grains slide away and pile up ahead of the wheel, as shown.



Note how treated grains pack properly under the polishing wheel when "setting up".

Most polishing is done with artificial aluminum-oxide grain. Silicon carbide is used for certain polishing operations on glass and granite, and natural emery has applications for some metal polishing. Rouge and pumice are used for certain finishing operations. It is essential that the abrasive be of high quality; for instance, it should be of great uniformity as to size of grain. Over-size particles will scratch the surface of the piece, while if there is an excessive amount of under-size grains, production will be slowed up.

The production efficiency of the abrasive depends to a great extent upon the shape of the individual grains. Ordinary artificial aluminum oxide as it comes from the crusher contains some weak grains, thin "flats," and long, narrow "slivers." These should be removed by its maker, as they have little polishing value and thus slow up production.

To get the maximum production from a polishing wheel, it is essential that the abrasive grains be sharp; that means that the grains must be irregular in shape, with angular edges—not rounded or smooth. Unless the grains possess a high degree of capillarity they will not be wet sufficiently by the glue and will tear out of the wheel face too readily. The capillarity should be permanent, that is, it should not be affected by exposure to the air.

By etching the abrasive grains chemically, the glassy, slippery surfaces are changed to improve the capillarity and to develop a property known as "surface tenacity." It is possible to control this property so that the ratio of glue to abrasive on the wheel will be correct and the abrasive securely held to the wheel. This gives a wheel with an open coating, which has a definite clearance between grains. The result is less filling of the wheel with abraded material, less frequent dressing, and longer wheel life.

Polishing grain comes in various standard sizes from No. 10 to No. 220. The accompanying table gives approximate sizes for many common polishing jobs. These should be taken as suggestions rather than as absolute recommendations. Only actual tests under shop conditions can safely be relied upon to determine the exact size of grain that will give the best results for a given job.

Preparation of the Glue

The efficiency and life of a polishing wheel depend to a great extent upon the preparation of the glue. It is essential, for instance, that the proportion of water to dry glue be correct. Tests show that for severe conditions, where the wheel comes in contact with rough corners and sharp edges, and abrasives of 24 to 36 grit are used, the proportion should be one part of water to one of glue.

For less severe work, consisting of plain surfaces with round corners, where 24 to 36 grit abrasive is used, ten parts of water to nine of glue is best. For similar work where grains of 36 to 54 grit are used, the proportion should be ten parts of water to eight parts of glue; and where the grit size is from 60 to 80 or finer, the proportion should be from ten of water to seven of glue to two of water to one of glue. These proportions are by weight. To measure the glue by volume is inaccurate, because the weight of a given volume varies according to the fineness of the glue.

Somewhat less than the full amount of cold water should be added to the glue and the mixture allowed to stand for several hours, or even over night. Enough soaked glue for three or four hours' requirement is

heated to 150 or 160 degrees F. in a water bath or in an electrically controlled dry bath. When the glue is completely dissolved, enough warm water is added to bring the mixture to the proper proportion of water and glue. Small quantities are prepared at a time, since glue that is kept hot for periods as long as a working day loses strength. Glue that gets hotter than 160 degrees F. also loses strength. Since destructive bacteria thrive in glue, it is necessary at the end of the day to clean the glue-pot and brush it thoroughly with hot water.

To prevent coarse and fine abrasive grains from becoming mixed, separate glue-pots are used for each grit size of wheel. Otherwise, small grits would be carried by the brush to the pot and transported by another brush to a wheel using coarse grit, and vice versa.

Coating the Wheels with Glue and Abrasive

Wheels are given a thin sizing coat of glue, a base coat of glue and fine abrasive (120 to 150 grit), and a final coat of glue and coarser abrasive. The sizing coat covers the face and sides. If the wheel has never been used, it is first trued on a lathe and marked with an arrow to show the direction of rotation, which should be the same for polishing as for truing.

If an old wheel is deeply pitted or covered with grease or oil, the old "head" should be completely soaked off with hot water. In cases where the sizing has been worn through, it should be resized with abrasive and thin glue. If the sizing is intact, the face and edges are trued with a silicon-carbide brick or a file. Oil or dirt on the wheel face should be removed with solvent.

In applying the final coat of glue and abrasive, it is necessary to spread the glue uniformly over the face of the wheel, and prevent it from jelling. To this end, the wheels are heated to about 120 degrees F. in a warming closet, and the same area of wheel covered with each brushful of glue. The grain is kept in a trough at 120° F., and the wet wheel rolled in it by hand with a moderate pressure or by a machine. To determine whether enough abrasive has been taken up by the glue, the wheel is rolled on a hard level surface. If some glue comes to the surface, the wheel should again be rolled in the trough of grain.

If the abrasive has been chemically treated to give it the proper surface, merely rolling the wheel in the trough will give the wheel the correct surface. However, if the abrasive grains have a shiny, slippery surface, it may be necessary to pound the wheel in the trough, which is undesirable. For some purposes, it is desirable to give the wheel a second coat in the same manner, after partially drying the first coat.

Importance of Proper Drying of the Coated Wheel

The drying process is very important. If insufficiently dried, the glue will remain in a jelly-like condition, the wheel will "load," and pieces of the face may tear out. On the other hand, if the wheel is over-dried the abrasive grain will tear out easily and the wheel will have a short life.

For drying, or "curing" as it is sometimes called, the wheels should remain in a room, the temperature of which is close to, but not more than 80° F., with about 50 per cent relative humidity, for forty-eight hours. To maintain these conditions, a separate curing room is essential. The results will be poor and not uniform, if, as is so often done, the wheels are cured in the setting-up room.

Since the humidity increases rapidly when a fresh batch of wheels is put in the curing room, it is essential that some means of maintaining the proper humidity be used. A recording psychrometer, which gives both temperature and humidity, should be installed and closely watched.

Grit Size of Aluminum-Oxide Grain for Polishing Operations
(Recommended by The Carborundum Company)

Material or Parts to be Polished	Operation Number 1	2	3	4
Aluminum, die-cast	150	Buff		
Aluminum, sand-cast, inside	36-46			
Aluminum, sand-cast, outside	60-80	120-180		
Aluminum, sheet	120	180	Buff	
Automobile bumpers	60-90	120	Buff	
Automobile fenders	90	120-150	150-180	220
Automobile headlights	180-220	Buff		
Automobile hardware	36-54	90		
Brass, sand cast	60-80	150-180	120	220
Brass, sheet	180-220	Buff	220-3F	
Cutlery	80	120		
Flat irons, electric	60-80	120	Buff	
Forks, hay	60-70	100-120	150	180-240
Forks, spading	24			
Gray iron, not pickled	70	120-150		
Gray iron, pickled	80	120-150		
Hammers	46-60	100-120		
Hoes, best quality	36-46	70	100-120	
Hoes, second quality	36-46			
Knives, steel blades	80-90	120-150	220-F	Buff
Knives, backs	46-60			
Knives, machete, edges	46-60			
Knives, machete, faces	80	120		
Monel metal, cast	80	120	150	Buff
Monel metal, deep-drawn	120	150	180	Buff
Monel metal, full finish sheet	180	220	Buff	
Plowshares	36-46			
Plow disks	30-46	70-90		
Shovels, blades	36-46	120		
Shovels, straps	36-60			
Steel, sheets for enameling	90	120-150		
Steel, stainless, mirror finish	60-80	100-120	150	220-3F Buff
Steel, commercial finish	80	100	120	150
Wrenches	30-46	80	120	

More uniform results will be achieved if the air is circulated artificially. Properly controlled temperature and humidity, together with adequate circulation of air, will greatly speed the curing process and produce better polishing wheels.

Decreased production in polishing is often blamed on wheels, abrasives, or glue, when the real trouble is in the setting-up or curing room. If all the processes and materials entering into the making of a polishing wheel are given close, intelligent study, it will often be possible to reduce polishing costs to a surprising extent.

PLATING AND FINISHING
POLISHING — BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

SHOP PROBLEMS

Removing Fire Oxide From Silver

Q. Please let me know the best way for removing fire oxide from silver.

A. The best way to remove fire scale from silver is by simple immersion in a solution of nitric acid and water; 75% acid and 25% water.

The work must be clean before going into the acid. Then immerse, or pour the solution over the work. Save the acid and rinse waters to recover silver as a chloride precipitate.

Electrolytic pickling can be done in a solution composed of:

Sodium cyanide	8 ozs.
Sodium ferrocyanide	8 "
Water to make	1 gal.

The work is made the anode and carbon cathodes are used. Work must be clean, and agitated during the process. Higher voltages are preferable for this work. Low voltage can be used but a longer time is required and the results are not as satisfactory. We suggest that the acid pickling method be tried before going to any expense on the electrolytic method as the latter is little used today.
—G. B. H., Jr.

Lacquering Gold

Q. We are experiencing a little difficulty in obtaining a desirable yellow color in our finished gold plated work. After the plating operation, the color is splendid but the subsequent lacquering and baking operations cause an objectionable and quite extreme deepening and reddening of the color. Lately, we have been making our gold plate several shades yellower than the shade finally desired, in order to neutralize somewhat the ill-effects of the lacquering operation, but even this has not removed the difficulty. Applying several layers of a more concentrated lacquer, seems to improve the color bringing it much closer to the original. However, this experiment did not show decisive results and so I would like to have your advice regarding the cause and cure of our difficulty.

A. Not having a sample of your work that you have in question, it is rather difficult to answer your problem definitely.

An analysis of your solution is recommended. For should your gold solution have low metal content, be highly concentrated with carbonates along with other foreign matter, and operated at high current densities, the results obtained would, without doubt, be dark and red, subject to change much darker to a red color when the subsequent lacquering operation is applied.

It should be borne in mind that lacquers, no matter how applied on gold deposits, will darken the color from one half to three shades darker. More so when baking lacquers are employed. The nitrocellulose constituent in some lacquers breaks down on long periods of time under high baking temperatures. The time element and temperature should be carefully studied in conjunction with the grade of lacquer you are now using.

As a cure, I would suggest that you bright nickel plate your work sufficiently to cover soldered joints, if any, then gold plate in the following solution:

Potassium gold cyanide (67% metal content)	½ troy oz.
Potassium cyanide	1½ avoir. oz.
Potassium phosphate (dibasic)	½ " "
Water	1 gal.

Temp. 135 deg. F., current density 0.3 to 1.0 amp./sq. ft., 2 to 4 volts; stainless steel anodes; plating time 15 to 30 seconds, or depending on the allowed cost for gold in plating.

Then spray or dip lacquer with a high quality clear lacquer, dry in oven temperature at 150 to 180 deg. F., for from 5 to 15 minutes. If a quick drying lacquer is used for spraying, allow work to air dry.—P. A. O.

Technical Advisors For September Issue

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Factor Derivation

Q. In looking over the 1940 Plating and Finishing Guidebook, particularly in the analysis of different plating solutions, I became puzzled as to how to solve the equation for the reaction between sodium cyanide and silver nitrate. I would also like to know how the factor 0.131 is obtained for computing the ounces per gallon of free cyanide from the silver cyanide titration.

A. In the analysis of free cyanide, silver nitrate is titrated against free sodium cyanide until all of the sodium cyanide has combined with silver nitrate to form the soluble sodium silver cyanide salt. Usually, potassium iodide is added so that as soon as there is no longer any sodium cyanide to react with the silver nitrate, a precipitate of silver iodide will form to indicate the end of the reaction. The equation for the reaction is as follows:

$$AgNO_3 + 2\ NaCN = NaAg(CN)_2 + NaNO_3$$

and

$$AgNO_3 + NaI = AgI + NaNO_3$$

You will notice from the first equation that 1 molecule of silver nitrate reacts with 2 molecules of sodium cyanide, or on a weight basis, 1 gram molecular weight of silver nitrate, namely 169.89 grams will react with a 2 gram molecular weights of sodium cyanide or 2 x 49 = 98 grams.

A normal solution of silver nitrate contains 0.16989 grams per cc. and 1/10th normal solution contains 0.016989 grams of silver nitrate. On the equivalents just mentioned, therefore 1 cc. of 0.1N silver nitrate solution is equivalent to 0.0098 grams of NaCN. Inasmuch as a 10 cc. sample was taken, to obtain the number of grams of sodium cyanide per liter, we must multiply 0.0098 x 100 x the num-

ber of cc.'s required in the titration. To change the factor to ounces per gallon, we multiply this product by 0.134, thus the factor is derived from:

$$0.00\%d \times 100 \times 0.134 = 0.131$$

—W. R. M.

Faulty Nickel

Q. We are sending you under separate cover a sample of our nickel plating solution. The work peels occasionally and the anodes turn red. We will be pleased to receive your advice as to means of correcting this solution.

A. The analysis of this solution shows:

Nickel	4.2	ozs./gal.
Chloride, as ammonium chloride	3.1	"
pH	5.0	"

The metal and chloride are O.K. although the metal need not be over 3 ozs./gal. for a cold solution.

The pH is too low. Before this is corrected, however, the solution should be treated so as to remove iron and copper which it contains as impurities, and which will cause the troubles mentioned.

Copper can be most quickly removed by hanging in clean scrap iron, in iron baskets or on wires. The copper will come out by displacement, overnight.

Copper will also come out on the anodes overnight, and if these are removed each morning and scrubbed, or bright dipped and thoroughly rinsed, the copper will gradually be removed. The displacement of copper will take place more rapidly at a low pH so that either of the above procedures is best done at the present pH of the solution.

Then bring the pH up by adding 30 fl. ozs. of ammonia to each 100 gallons of solution. Also add 1 pint of 100 volume peroxide to each 100 gallons of solution. This should be done at the end of the day. Most of the iron will be precipitated to the bottom, as a mud, and should be taken out of the tank. More complete removal of the iron can be effected by warming the solution, and raising the pH to 6.6 but in this case, filtration should be performed, as the iron so precipitated will largely be taken back into solution when acid is added to bring the pH back to 5.8—G. B. H., Jr.

Stored Gold Solution

Q. My gold plating solution is composed as follows:

Gold chloride	1½	ozs.
Potassium cyanide	5	"
Water	½	gal.

I put the gold plating solution in a large bottle and closed it with a rubber stopper. The solution was not used for 10 years, and last month I opened the stopper and smelled ammonia. If the solution is spoiled for electroplating, I would like to learn the following:

1. How the solution may be repaired for electroplating.

2. How to remove either gold chloride or metallic gold from the solution.

A. The fact that your gold solution smelled of ammonia does not necessarily mean that the solution is no good. Cyanide salts decompose into many products, and one of them is ammonia.

In answer to your question as to how to fix the solution, we can only advise that you have it tested. There are companies that advertise in the METAL FINISHING which perform this service.

If you wish to recover the metal from the solution stir in a quantity of granulated zinc. Let stand for a few days, stirring occasionally. The gold will come out on the zinc. Filter off the liquid, saving the zinc mud. Wash the mud with water. The zinc is then dissolved out of the mud by adding dilute sulfuric acid (1 part acid—4 parts water). The remaining solid will be mostly gold, with some contamination. This gold can be dissolved in aqua regia, and the solution thus obtained evaporated slowly to a heavy syrup on a water bath to drive off excess acid. Add water, and then ammonia, which precipitates gold fulminate. Filter off the fulminate, and wash with water. Do not allow fulminate to become dry as it is explosive when dry. The fulminate can then be used to prepare a gold solution with cyanide and other constituents as desired.

In view of the amount of work involved it is often more advisable to send such solutions to a refiner. For preparation of a new gold solution consult the "Plating & Finishing Guidebook" published by the METAL FINISHING, a free copy of which is sent with a subscription. This booklet also gives formulas for nickel plating solutions. There is a patent on the mixture used for brush plating sample of which you enclosed. It is patent No. 2,061,591. Also No. 2,061,592. Each patent costs 10c and can be obtained from the Commissioner of Patents, Washington, D. C. Send cash or money order, no stamps.

Gold and silver plating cannot be done at 110 volts. Rectifiers are used to supply the plating current for some uses, but such devices transform the current to lower voltages at the plating terminals, even though the supply current is 110 volts.—G. B. H., Jr.

Removing Surplus Tin

Q. Please advise me of a method for removing surplus tin from the surface of hot dip tinned articles.

A. In regard to a special compound for stripping tin from hot-dipped articles, I do not know of any. The usual material used is a very high grade of prime tallow. This is called "finishing grease". The method consists of first putting the article through a good commercial cleaning bath, pickling, fluxing and then immersing in what is called a "rough tin" bath, then to a "rough grease" (tallow) pot, then to the finishing tin pot; the finishing grease pot and list pot; finally in a steam coil heated oil dip, then to a wipe of cedar (fine) sawdust and kerosene oil; a whiting wipe and finally a fine pine sawdust wipe, after which the surface is polished with a soft cloth.

For rough work such as casting, etc., the method is simpler, but, of course, the quality of the finish is not as good. In some cases only one tin pot is used. The flux used is the regular tinning flux of zinc chloride. Some companies use palm oil on the tin bath to strip off the excess metal and also for the purpose of preventing oxidation. Others use tallow. After the work has been thoroughly cleaned, it is dipped in the flux solution and then dipped in the tin bath covered with about 2 inchs of high grade tallow (it is very important to use only a good high grade of prime tallow for stripping), which results in a smoother deposit of metal, strips off the excess tin and prevents oxidation and discoloration of the finish. After withdrawing from the tin bath, the work should be quenched in a kerosene oil quench (cooled by a water jacket), and then wiped in sawdust, after which the sawdust can be entirely removed by blowing the work with a high pressure air hose.

Attention is called to the fact that there are many fields of hot-dip tinning and special methods and materials have been found to be most satisfactory in each field. The hot-dip tinning of kitchenware and hotel ware, milk cans and ice cream cans, dairy pails, etc., requires two tin pots or baths, and a number of grease pots to obtain the fine, smooth bright tin coating found on these articles. Other kinds of work require less care and only one tin bath. Where the finish is not of so much importance, but only protection is required, the entire equipment and setup may be very simple. Paraffin oil has also been used as a quench bath. Suitable material for this work may be obtained from any of the large oil companies.—W. I.

Finish on Razor Blade

Q. I am enclosing herewith a sample of a razor blade, and would like to know what finish is used on the sample as I would like to duplicate it.

A. This finish appears to be a brass plate that has been lacquered with a gold dye lacquer.

For details on formula and operating conditions for brass plating, see the 1940 edition of the Plating & Finishing Guidebook published by Metal Industry Publishing Co.

The general principle of gold dye lacquering is to lacquer with a clear lacquer and allow to dry. The article is then dipped into a solution of dye, which gives the gold shade to the lacquer film.

The color may also be obtained by printing the strip with a lithographers' "lacquer" of the desired color.—G. B. H., Jr.

ELECTROPLATING DIGEST

SELECTED ABSTRACTS ON PLATING—FINISHING—RUST PROOFING—LACQUERING

Protection of Magnesium and Its Alloys from Corrosion

U. S. Patent No. 2,197,611. *J. Fischer and W. Richter, assignors to Siemens & Halske, A.G., Germany. Apr.* 6, 1940. A process comprising the anodizing of the article in aqueous solution of hydroxide from the group consisting of alkali metal hydroxides, alkaline earth hydroxides and aqueous ammonia, and a salt selected from the group consisting of water soluble carbonates, silicates and borates, and a salt selected from the group consisting of simple cyanides, thiocyanates and cyanates of the alkali metals at 20°—25° C. and 1—110 volts. For example:

Sodium hydroxide	5%
Sodium carbonate	5%
Potassium cyanide	2%
Sodium tungstate	0.1%

20° C., 16 volts. Current starts at 5 amps./sq. dm. and drops to 1 amp./sq. dm. after 30 seconds. Treat for 1 hour. Coating may be dyed.

Gold Colored Alloy Deposit

U. S. Patent No. 2,198,365. *L. Cinamon and S. Sklarew, assignors to Special Chemicals Corp.* April 23, 1940. A process of depositing a gold colored copper—zinc—tin alloy plate using an aqueous alkali cyanide solution containing copper salts, zinc salts and tin salts, the quantities being such that the metal content of one gallon of solution will be from about 2.8 grams to saturation of copper, 7.7—40 grams of zinc and 3.7—59 grams of tin and having a free alkali cyanide content of from 1—5 ozs./gal. while maintaining a pH of 12.7 to 13.1. Other materials may be added for conductivity and brightness. A table of such materials is given in the patent. Example:

Copper cyanide	73.80	grams/gal.
Zinc sulfate	10.52	"
Zinc oxide	15.78	"
Sodium stannate	10.70	"
Trisodium phosphate	10.70	"
Rochelle salts	6.10	"
Sodium cyanide	169.65	"
Sodium carbonate	56.00	"
pH	12.7—13.1	

Temperatures between 20° C. and 75° C., preferably 20°—25° C. Voltage 4—9 volts, preferably 5 volts. Current density 25—60 amps./sq. ft.

Soluble anodes of copper—zinc—tin alloy or individual soluble anodes of these metals, or insoluble anodes may be used. The zinc plates out more rapidly than the copper, and the tin less rapidly.

Protection of Magnesium and Alloys from Corrosion

U. S. Patent No. 2,196,161. *J. Frasch, assignor of one half to Samuel Fratkine, France. April* 2, 1940. A process comprising anodic oxidation in aqueous solution of caustic alkali equipment to 5—20% sodium hydroxide and thereafter subjecting the oxidized surface to a vitrifying treatment with an aqueous solution of a soluble silicate. Example:

Sodium hydroxide	5—20%
Sodium silicate	2— 3%
Precipitated aluminum silicate	2— 3%
Potassium permanganate	0.1—0.2%

Temp. 40°—60° C., 8 volts; 50 amps./sq. ft. Time 15 minutes. Iron or carbon cathodes are used. After anodizing, the articles are rinsed and vitrified by immersion at 90° C in:

Sodium silicate	5—30%
Sodium hydroxide	3— 4%
Aluminum silicate	1— 2%

Removal of Nickel

U. S. Patent No. 2,200,486. *E. F. Burdick, assignor to Western Electric Co., Inc.* May 14, 1940. A solvent for the removal of nickel and the like coatings from an iron bearing base, consisting of concentrated nitric acid and a chlorine compound soluble in the nitric acid, the chloride compound being added in sufficient quantities to establish a nitric acid: chlorine ratio equivalent to that of 0.03—0.10 grams of NaCl dissolved in 100 cc. of nitric acid. For example: To 100 cc. of 1.40—1.42 density nitric acid add 0.03—0.10 grams sodium chloride (0.056 grams preferably), or to 100 cc. of 1.40—1.42 density nitric acid add 0.04—0.20 cc. of concentrated hydrochloric acid of sp. gr. 1.16 (preferably 0.08 cc.). Strip is claimed to be quantitative and will remove 50 mg./sq. in. of nickel in 5 minutes.

Bright and Ductile Nickel Plate

U. S. Patent No. 2,198,268. *R. Lind, W. J. Harshaw and K. E. Long, assignors to the Harshaw Chemical Co. April* 23, 1940. Brightener for nickel plating solutions consisting of an amino polyaryl methane compound in which at least one amino group is attached to an aryl group and a substance of the class consisting of single ring aryl sulfonamides and sulfimides. For example: carbitol of fuchsin, reduced fuchsin or fuchsin, 2 to 100 mg./liter and paratoluene sulfonamide, at least ½ g./liter and enough to produce ductility. See patent No. 2,198,267.

Bright and Ductile Nickel Plate

U. S. Patent No. 2,198,267. *R. Lind, W. J. Harshaw and K. E. Long, assignors to the Harshaw Chemical Co. April* 23, 1940. Brightener for nickel plating solutions consisting of an aminopolyaryl methane compound in which at least one amino group is attached to an aryl group and a naphthalene sulfonate. For example:

Single nickel salts	120—150 g/l
Nickel chloride	15— 75 "
Boric acid	15 g/l to saturation
Fuchsin	2—100 mg./l

One or more compounds of the mono, di or trinaphthalene sulfonate class ½ g/l to saturation. Table of various other brightening agents of this class is given.

Metal Polish

U. S. Patent No. 2,196,992. *E. W. Keller. April* 16, 1940. A liquid metal polish composition consisting of finely divided tin oxide, sodium silicate having a $Na_2O:SiO_2$ ratio of about 1:3.86 corresponding to a density of 33.5° Be. plus a sodium salt of lauryl alcohol sulfate for preventing caking on standing, such as Duponal. The wetting agent and tin oxide are mixed before adding the sodium silicate.

Bright Zinc Plating

U. S. Patent No. 2,196,588. *R. O. Hull, assignor to E. I. duPont de Nemours & Co. April* 9, 1940. Patent claims a process for depositing from a cyanide solution containing an oxyhereocyclic compound selected from the group consisting of piperonal, piperonyl alcohol, piperonylic acid, piperine, safrole, acetophenone, coumarin, furfural, furfuran, puronine, tetrahydrofurfuryl alcohol, hydrofurfuramide, paraldol, ethyl furoate, methyl furoate, furfuralamine, tetrahydrofurfurylamine, dihydroxymethylxanthane, fluorescein, morpholine, ethanol, phenyl morpholine hydrochloride, butyl morpholine hydrochloride, diphenylene oxide, cyclohexene oxide, glycol formal, coumalic acid and furamide and about 0.01—1.0 g/l of a protective colloid selected from the group consisting of gelatin, gum arabic, gum tragacanth, agar-agar and soluble starch: for example:

Zinc cyanide	60 g/l
Caustic soda	78 "
Sodium cyanide	42 "
Piperonal	1 "
Gelatin	0.1 "

Fundamentals of Science Relating to Electroplating

This is the first article in a series which will be devoted to an exposition of principles of chemistry, metallurgy, and electrochemistry. The articles will be written from the viewpoint of the non-technical man and for a better understanding of the principles of electroplating.—Ed.

Introduction

The usefulness and application of a process or of an art does not, of course, require an understanding of the fundamental principles involved in it, but for practice to be most efficient and for progress to be most rapid the "why" and "wherefore" must be considered. From the period of the Stone Age, Man, such as he was, began to use metals but thousands of years passed before progress received a real acceleration and impetus through the medium of theories and hypotheses and the experimental investigations of natural phenomena. Furthermore, the blind and little-understood performance of an act for the sole purpose of securing a result makes for an atmosphere or feeling of magic and supernatural, as witness even today the appeal to the uninitiated layman with such terms as "Chemical Magic," "House of Magic," "Magic Eye," etc.

It is unfortunate that the electroplating industry has suffered from the malady of blind activity for about a century. As long ago as 1835, Faraday announced the fundamental laws of electroplating, and that period marked also the beginning of industrial plating. Yet it is really only in the past two decades that any appreciable insight into the mechanism of plating has been obtained and it is no haphazard coincidence that only in this period have somewhat radical changes been made in the application of plating processes, for example, the advent of bright deposits. Even today, however, the science of electroplating is, scientifically speaking, almost the "forgotten child." Only as the men who live by this art educate themselves beyond the mere production figures, demand that more understanding of their processes be obtained and offer inducement to others to obtain this understanding, will the electroplating industry grow as it deserves to and can grow.

It is with such thoughts in mind, attempting to increase efficiency and production by understanding "why" and "how," to make the electroplater independent of any "witch doctors" of the industry by removing the magic, to create a demand for more fundamental work by making the industry "technical-minded" and to increase the pleasure and enjoyment of the work itself by removing some of the fog and haze and hocus-pocus which might surround it, that this series of articles is being written.

The Atom

Anything upon which we may lay our hands or which occupies space is MATTER; and all matter may be broken down eventually into fundamental ingredients, called ELEMENTS, of which, it is thought, there are only about 92 different varieties. These elements alone or in various combinations constitute, then, the entire Earth, and the Universe, in which we live.

The idea of the world being built up of a relatively few elements dates back to five or six centuries B.C. Primarily, the Hindu and Greek philosophers introduced this concept, first claiming that water alone was the primal matter and then including fire, earth and air—the "Big Four" of ancient history. The ether was added to this list soon after. Today, of course, the concept of ether is no longer used and the "Big Four" are known to be themselves combinations of real elements. This same period in history saw also the beginning of theorizing, which was more metaphysical, however, than physical, and the name of the Greek philosopher Thales stands out as one of the first to ask why a thing happened. Thales also is given credit for being our first "absent-minded Professor" for it is told that while studying the stars he walked into a stream, causing a girl who observed this to deride him from being so intent with the heavens that he overlooked what lay at his feet, a thought too generally applicable even today.

While differing from each other in properties and characteristics, each element, however, is made up of unit building blocks which in every case are similar in structure regardless of the element. These fundamental units comprising the elements, in size only about one hundred millionth of a centimeter (about four billionths of an inch), are called ATOMS, and although their individual weights, sizes and outer configurations differ from one to the other, their general inner make-up is the same. This general concept also dates back to ancient history, probably to the Greek Democritus about 500 B.C. The word "atom" in fact comes from the Greek meaning indivisible, a belief that was prevalent until relatively modern times.

Now atoms are held together to form elements and other forms of matter due to electrical and magnetic forces of attraction, some of which we shall investigate later. At the same time, the individual atoms are not pulled together into one solid mass because they are eternally in motion and it is the relative strength of the two conflicting tendencies, motion vs. mutual attraction, which determines whether the substance is solid, liquid or gaseous, the only three possible states of matter. In a gas, the motion of the atoms is so intense that rarely can two atoms get together for any appreciable time. At the other extreme is the solid, where the motion is so sluggish, though still existant, that the electrical and magnetic forces hold the atoms together sufficiently tightly to give an outer appearance of immobility and rigidity. Thus a table or chair is really made of moving parts. In between these extremes come, of course, liquids. As far back as the seventeenth century, Hooke, an English physicist, used the following analogy to illustrate this difference, as between solids and liquids.

". . . let us suppose a dish of sand (which normally lies quiet and rigid as a solid) set upon some body that is very much agitated, and shaken with some quick and strong vibrating motion—. By this means the sand in the dish, which before lay like a dull and inactive body, becomes a perfect fluid; and ye can no sooner make a hole in it with your finger, but it is immediately filled up again, and the upper surface of it leveled. Nor can ye bury a light body—but it presently emerges or swims as 'twere on the top; nor can ye lay a heavier (body) on the top of it, as a piece of lead, but it is immediately buried in sand, and (as 'twere) sinks to the bottom. Nor can ye make a hole in the side of the dish, but the sand shall run out of it to a level. Not an obvious property of a fluid body, as such, but this does imitate; and all this merely caused by the vehement agitation of the containing vessel; for by this means, each (grain of) sand becomes to have a vibrative or dancing motion, so as no other heavier body can rest on it, unless sustain'd by some other on either side."

This dancing action of the atoms in a body, which determines whether that body shall be solid, liquid or gaseous, is in reality the heat of the body, and, conversely, by the application of heat, for example, to water, the motion can be so increased that liquid water becomes the gaseous water which we call steam. On the other hand, by reducing this motion, that is by cooling, we convert liquid water into ice and if we go far enough, down to a temperature which is called absolute zero, (—459° F.) there would be no motion at all. Very recently, physicists have arrived within a fraction of a degree from absolute zero and have found that metals have many unusual properties at that temperature, such as a super electrical conductivity.

Although the original concept of an atom considered it inadvisable, the atom has now been smashed, to use a popular expression. Its general structure was originally described in its essential details by Niels Bohr, a Danish physicist. It consists of a central nucleus surrounded by concentric "shells." The nucleus has a net positive electrical charge and is relatively heavy, accounting for practically the entire mass of the atom. It is, however, extremely small, there being approximately a million millon to the centimeter (about 2.5 million million to the inch). It has been said that if a large raindrop were to be magnified to the size of the earth, the atoms would then be as large as tennis balls but the constituents of the atoms would still be invisible to the naked eye. The shells, on the other hand, take up much more space, their diameters being roughly about 10,000 times as great as that of the nucleus. They are populated by *ELECTRONS*, which are rather vague things known more by their properties and effects than by their constitution, and are all alike. Electrons are very light, having a mass of 1/1835 of that of the hydrogen atom which is the lightest atom of all and they are negatively charged, each to the same degree. There are enough of these electrons surrounding the positively charged nucleus to make the entire atom electrically neutral. The number of such electrons is called the *ATOMIC NUMBER* of the atom and has a real importance in the system of chemistry. As a matter of fact, the nucleus itself is made up of electrons (roughly about half the total number in the atoms) together with positively charged particles called PROTONS, but for our purpose the nucleus and its structure are unimportant. In the atom of a given element, it is the electrons in the shells around the nucleus that determine for the most part the properties of the atom.

The inner atomic system is by no means a rigid, stationary picture. Actually it more closely resembles a small planetary system like the Earth and other planets revolving in certain orbits around the sun. The electrons are attracted toward the nucleus by electrical and magnetic forces, and these are counterbalanced by the forces due to the revolution of the electrons in their paths.

The electrons, in constant rotation about the nucleus, exist in certain stable combinations in their respective shells. When for any reason, a shell, the outermost shell, does not contain the proper number of electrons for stability, for example eight, the entire atom becomes chemically reactive, and it is possible, in fact, to vary the number and condition of these outer electrons with corresponding changes in the chemical reactivity of the element. This subject will be treated in more detail later.

However, while the activity of the atom and therefore the element can be affected by manipulation of the outer electrons, the element itself is not basically changed, for as long as the nucleus remains intact, the final stable state of the atom must be the same. If, however, the nucleus is permanently changed, then a new atom and a new element has been formed and we are dealing with what the predecessors of chemistry, the ardent Alchemists, called *TRANSMUTATION*.

It is interesting to digress for a moment on the subject of ALCHEMY, which was in reality chemistry in the early centuries. C. E. Legend has it that in the beginning, the divine arts were revealed to man by angels who descended from heaven because of their love for mortal women. These secrets were recorded in the book called Chemu, of a mythical person Chemes, whence comes the name Chemeia and, eventually, Chemistry. Actually, however, the origin of the word is probably from Chemi, the Greek word for Egypt, meaning dark, i.e. the country of dark soil. The Egyptians were early skilled in chemical knowledge so that their art became known as "al Chemi," westernized to "Alchemy." Alchemy became, essentially, the art of converting or transmuting base metals like lead into precious metals like gold, a goal that later was scoffed at by our modern chemists, only to become, in relatively recent years, an actuality. It is an ironical fact, however, that the first transmutation of metals, manifested in radioactivity, was beyond the control of Man and, in contradistinction to the original aim of the alchemists, converted a metal more precious than gold (namely, radium) into the base metal lead.

This brings us back to the subject of changing the nucleus. A change in the nucleus can be effected, from what we have already said, only by adding or subtracting protons or electrons. This process is exemplified perfectly in radioactive substances. In this process, electricity is emitted from the nucleus in two forms, known as alpha particles and beta particles. Each of the former corresponds to two protons (units of positive electricity) and each of the latter to one electron (unit of negative electricity). As these particles leave the parent nucleus, a different nucleus (and therefore eventually a different element) is formed which itself emits such particles to form still a different element, and so the process continues until the substance, for example lead from radium, is no longer radioactive. In modern times, artificial radioactivity has been induced in elements and new and more powerful projectiles and methods have been discovered with which to bombard the nucleus, so that deliberate transmutation of a variety of elements has become not only a laboratory fact valuable for further experimentation and theorization, but a performance of practical importance, especially in medicine.

We have discussed now the division of matter into elements and elements into protons and electrons.

This is schematically illustrated in Fig. 1.

It will be noted that an alternate method for constructing matter is indicated, namely, using molecules and compounds, and this subject will be discussed in the next article.

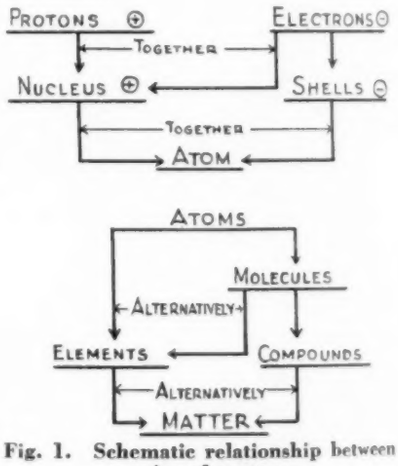


Fig. 1. Schematic relationship between units of matter.

Atomic Weights of Elements

Aluminum	26.97	Cobalt	58.94	Magnesium	24.32	Selenium	78.96
Antimony	121.76	Copper	63.57	Manganese	54.93	Silicon	28.06
Arsenic	74.91	Fluorine	19.00	Mercury	200.61	Silver	107.88
Barium	137.36	Gallium	69.72	Molybdenum	96.00	Sodium	23.00
Beryllium	9.02	Germanium	72.60	Nickel	58.69	Strontium	87.63
Bismuth	209.00	Gold	197.2	Nitrogen	14.01	Sulfur	32.06
Boron	10.82	Hydrogen	1.01	Oxygen	16.00	Tantalum	181.4
Bromine	79.92	Indium	114.76	Palladium	106.7	Tellurium	127.61
Cadmium	112.41	Iodine	126.92	Phosphorus	31.02	Tin	118.70
Calcium	40.08	Iridium	193.1	Platinum	195.23	Titanium	47.90
Carbon	12.00	Iron	55.84	Potassium	39.10	Tungsten	184.00
Chlorine	35.46	Lead	207.22	Radium	225.97	Vanadium	50.95
Chromium	52.01	Lithium	6.94	Rhodium	102.91	Zinc	65.38

Post Scripts

Picnic Days Ahead for A.E.S.

September 7th—Newark Branch, Union, N. J.

September 14th—Bridgeport Branch, Eichner's Grove, Trumbull, Conn.

September 28th—Leacrest Party, Bethlehem, Conn.

+

Byron Hogaboom sent us a "chuckle" from the August 17th, N. Y. Times, that ought to be of particular interest to "Metals and Alloys." In discussing manganese, it stated: "Manganese is used to purify and *deodorize* steel," Gosh—maybe that's why they call a certain iron "pig iron."

+

We were always amazed at *Derick Hartshorn's* ability to bend spikes and tear directories in half but when we saw his 120 lb. wife, Eleanor, tear beer cans apart, we started to wonder what type of food the Hartshorn clan eats.

+

"Iron Age" boasted a few weeks ago about its phenomenally high subscription renewal percentage of approximately 81%. Maybe we ought to boast a little about METAL FINISHING's renewal percentage which is now over 80%.

+

Bert Sage is back in Boston environs hanging his hat at 25 Sachem Street, Salem, Mass., and drawing his pay check from A. S. Campbell Company again.

+

Nate Promisel, now an industrial consultant and formerly with the International Silver Co., Meriden, Conn., will write a series of educational articles on principles of chemistry, metallurgy, and electrochemistry for the electroplater. They will be written for the non-technical man, but we hope even you B.S.'s and Ph.D.'s will find them interesting. The first installment appears in this issue.

+

DuPont's *Ralph McCahan*, some years ago, worked for the Hanson-Van Winkle-Munning Co. in Ohio and one day while driving, encountered ostensibly a heavy fog and had to stop his car at the side of the road. After waiting for some time, Ralph got out of the car and walked ahead to see what the road was like. After going a couple hundred yards, the "fog" cleared. To Ralph's amazement he saw a building afire and the fog was only heavy smoke.

+

Speaking of fog, *Dr. Blum*, a couple of years ago had an interesting experience. He was returning to Washington from Pittsburgh after inspecting test panels, and he struck a pea soup fog going over the Allegheny Mountains. He managed to get behind a truck, the driver of which apparently knew the road. After leading Dr. Blum through the great unknown, the truck stopped suddenly and so did Dr. Blum, who climbed out to see where he was. To his amazement, he followed the truck right up into a back yard, well off the highway.

+

To *Arthur Hothersall* at Woolwich Arsenal, outside of London. Every time we read of bombings near London we think of you and pray that you and your family are safe.

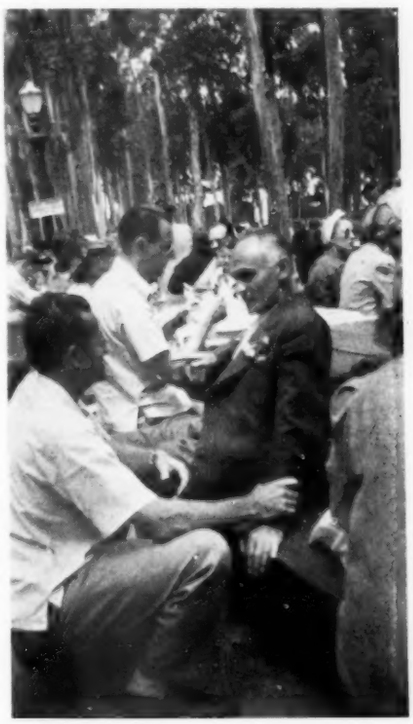
+

Phil Ritzenthaler is not an ordinary dirt farmer of West Allis, Wis., he is an advocate of hydroculture, sand gardening or whatever they call raising vegetables with chemicals and sterile sand. Phil claims to have raised 10 foot tomato plants.

+

Los Angeles Chapter Picnic Side-Lights

M. D. Rynkofs, head of the Liberty Plating Co., this year retained a distinction he had won at previous annual picnics of Los Angeles Chapter. The Rynkofs party was again the largest present, consisting of Mr. and Mrs. Rynkofs, son Eugene, three married daughters and their respective husbands, and five grandchildren.



Deeply immersed in profound discussion at Los Angeles' picnic are Irv Frauenhof of Price-Pfister Co. (L) and Ray Solivan of M.G.M., past and present secretaries of the chapter. Busy with his fodder, in the background, is Emmette Holman of Turco Products Co., chapter librarian.

+

Chapter President *Don Bedwell* of Los Angeles was the recipient of considerable joshing at the annual picnic in July when Mrs. Bedwell won a cash prize in a contest—while Don was holding the hat out of which the tickets were being drawn.

+

Stanley Rynkofs, assistant to his father, *M. D. Rynkofs*, in the Liberty Plating Co., Los Angeles, was married on August 11 to Miss *Mary Moore*, also of Los Angeles.

+

At Sandy Mac's

The Detroit Branch A.E.S. picnic was held Saturday, August 3rd at the usual spot—Sandy Mac's Golf Course, so the boys would have a 40 acre fenced inclosure to wander around in and still not get lost.

+

The weather looked threatening in the morning, but cleared up, and there were 225 present including Pres. *Fulforth*, Past President, *Goodsell*, and Secretary *Kennedy*. *Bob Green* boasted the distance he came for the picnic, but we believe *Doug. MacDermid* came about as far.

The sweet corn was ready to eat at 2 o'clock, and everybody grabbed a plate, put 3 or 4 cooked ears, and 2 or 3 sandwiches on it, and sat down to eat. We also wonder how the members could line up for a second and third helping—but they did, and Sandy Mac says he had cooked nearly 1,000 ears of corn which disappeared quickly.

+

After the eats, those who were able to stand took part in the games which consisted of skill in golf, horse shoe pitching, base ball, horse & rider polo, egg throwing, leap frog, mother-in-law special, and tug of war. In the tug of war Pres. *Fulforth* and Past Pres. *Goodsell* were the captains. It could be said here that Prexy Fulforth can take lessons from exPrexy Goodsell in tug of war technique.

Phil Brockway, the Ford Maestro, won the best dressed man prize going away. It seems that *Albert Payson* of the Virginia Paysons, was called elsewhere, and did not attend the picnic, thereby leaving the field clear to Phil.

Walter R. Meyer

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

New Buffing Compositions

LaSalco, Incorporated, 2822 LaSalle Street, St. Louis, Mo., have announced the development of two new buffing compositions.

One composition, called "K.M. Opalite," is recommended for the buffing of aluminum and is claimed to produce a high color. It is stated to be very economical, in that it adheres well to the wheel, requiring but few applications. It leaves the work clean and bright and large users of this material are reported to obtain greater production at a lower cost.

The second composition, called "Plastipol," is designed for the polish of all types of plastics. It is stated to give a quick smooth high color and will not burn or tint the work.

Costly cleaning operations are said to be eliminated because the work leaves the wheel with practically no grease or composition adhering to it.

New Polishing Lathe

A new addition to the Hammond of Kalamazoo line of Rite-Speed Polishing and Buffing Lathes is the model 10-ROH as shown.

This polishing lathe has an "overhanging" spindle, the front section overhanging 12½" from lower front of base.

This lathe is especially desirable on large bulky pieces.

New polishing lathe with large overhang.

Standard equipment includes spindle lock for holding spindle when changing wheels; combination switch and brake which shuts off motor and instantly stops the revolving spindle; automatic motor starter; up to 10 H.P. motor with Multi-V belt drive mounted inside the base.

For more complete information, write the Hammond Machinery Builders, Inc., 1601 Douglas Ave., Kalamazoo, Michigan.

Filter Mesh for Faster Filtration

Paramount Rubber Service, Inc., 1430 Rosedale Court, Detroit, Mich., have announced a material for faster filtration called, "Filtomesh." This material is a specially designed rubber "cushion," which is used between the filter plate and filter medium—cloth, paper or fibre glass. It is said to be applicable to all types of filters in which the filter medium is backed by a channeled or perforated plate or disc. "Filtomesh" is corrosion-resistant but should not be used with concentrated acids at elevated temperatures. Inquirers should specify the type of service with full particulars when making inquiry.

Some of the advantages claimed for the use of "Filtomesh" are: the normal rate of flow is maintained over greatly extended periods; reducing cleaning operations (and costs) as much as from 50 to 75%; the clarity of the solution is improved resulting in smoother and brighter plated coatings; roughness of the deposit is reduced.

In plants where the cake is the product, the "Filtomesh" is said to increase the output by 50%.

New Metallizing Process for Plastics

Special Chemicals Corporation, 30 Irving Place, New York City, have announced a new process called "Metalon Encasing Process," for plating upon plastics. The development is a result of five years research by the company's chemists.

The process is said to be suitable for all types of plastics and does not involve etching or sand blasting to produce a rough surface. The process allows plating on the smooth surface of the plastic, resulting in a brighter plated coating, thus cutting finishing costs to a minimum.

The metallizing is simple and rapid with low material costs; no license fees or royalties are required. The company has a complete outfit for finishing sample work and engineers are available for large scale installations.

New Cleaner For Brass & Bronze

Oakite Products, Inc., 18 Thames Street, New York, N. Y., have announced a new process for cleaning buffed brass and bronze before nickel and chromium plating. The process called "Oxbrite Process," is said to assure freedom of peeling of plated work, to eliminate hand brushing and wiping. It is said to obviate the need for a copper strike before nickel plating and permits soft soldered work to be bright nickel plated without first copper plating. Brighter and more uniform deposits are claimed because of cleaner, unetched metal surfaces.

Buffing Wheel Chart

The American Buff Corporation, 228 N. Clinton St., Chicago, Ill., to help manufacturers derive greater efficiency, have made an analysis of buffing speeds for various sizes of buffs. The company has just prepared a chart that indicates the peripheral speed of the buff or the number of surface feet of buff per minute,—given the speed of the wheel and the diameter of the buff.

This chart can be obtained free of charge by asking for the American Buffing Speed Chart.

New Bias Type Buffs

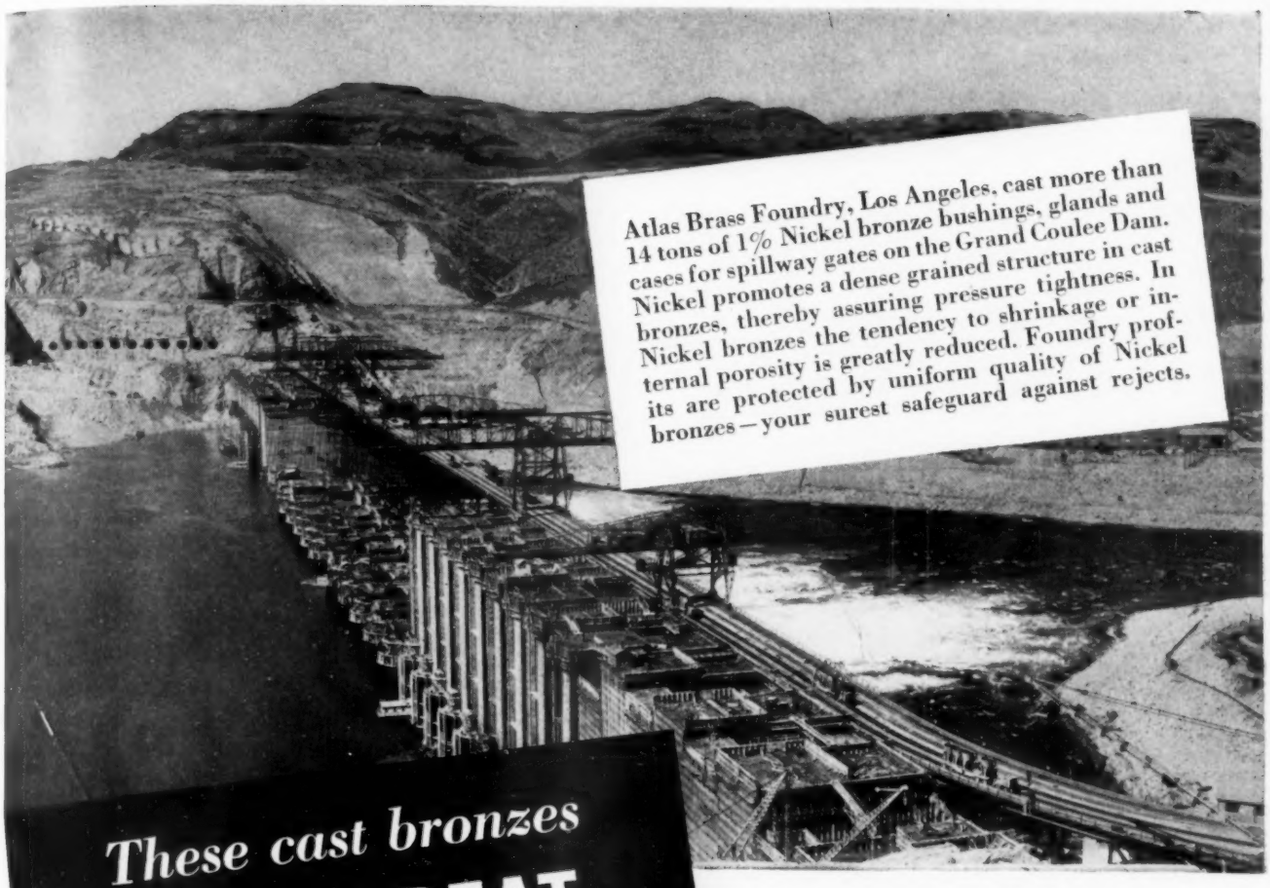
American Buff Corp., 228 N. Clinton St., Chicago, Ill., have announced the development of two new bias type buffs called the "Amflow" and the "Shurflow". Careful attention to details of construction have been given each buff. They are both of the bias type, ventilated, air-cooled and are said to be especially valuable

Professional Directory

G. B. HOGABOOM, JR. & CO.
Consulting Chemical Engineers
Solution analysis, plant design, process development. Testing of deposits—composition, thickness, porosity, salt spray.
352 Mulberry St. Newark, N. J.

CUT COSTS, BUILD PROFITS
With Controlled Metal Finishing.
Tests, Analyses, Advisory Service.
JOSEPH B. KUSHNER, B.S. Ch.E.
Electroplating Consultant
126 W. 32nd St. N. Y. C.
Telephone PEnn. 6-2214

Any plating solution analyzed for $1.
Reagent solutions for analyzing 25c. pt.
Platers' Laboratory Service
1153 St. George Ave., Roselle, N. J.



Atlas Brass Foundry, Los Angeles, cast more than 14 tons of 1% Nickel bronze bushings, glands and cases for spillway gates on the Grand Coulee Dam. Nickel promotes a dense grained structure in cast bronzes, thereby assuring pressure tightness. In Nickel bronzes the tendency to shrinkage or internal porosity is greatly reduced. Foundry profits are protected by uniform quality of Nickel bronzes—your surest safeguard against rejects.

These cast bronzes EASILY BEAT SPECIFICATIONS

...aided by NICKEL

Coupling cases, stuffing boxes, nut tube glands and hub glands cast in 1% Nickel bronze by the Atlas Brass Foundry. These were used by Consolidated Steel Corporation, Ltd., Los Angeles, in fitting 8½′ gate valves for the Grand Coulee Dam. Average tensile values from fifteen test bars exceeded specifications by more than 33%.

The improved strength and toughness of Nickel brasses and bronzes permit more compact designs. Though strong and tough, Nickel alloyed bronze materials are readily machinable. Using the right Nickel alloys in the right places will make foundrymen, shop men and customers 100% happier. Consultation on your problems is always welcomed.

1. *Coupling Cases*
2. *Stuffing Boxes*
3. *Nut Tube Glands*
4. *Hub Glands*

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

STAINLESS STEEL POLISHING COMPOUNDS

Are Proven Every Day in Every
Kind of a Metal Working Plant

"4-A" Polishing Compounds Are Faster, More Efficient, More Economical for Polishing, Mirror Finishing of All Kinds of Steel, Including Stainless Steel and Other Alloys.

Use it on any kind of a wheel, soft, hard, medium. Results will speak more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem. No obligation, of course.

CEMENT AND THINNER

Instead of glue, use "4-A" Cement and Thinner, a uniform substitute for polishing Wheels, Belts, Buffs, Rolls, etc.

Samples of Compound or Cement sent on request.

HARRISON & COMPANY

HAVERHILL, MASS.

A NEW NICKEL STRIPPING PROCESS USING

STRIPODE

(Patent applied for)

An inhibiting agent for Sulphuric Acid strip baths that—

PREVENTS PITTING AND ROUGHENING OF THE BASE METAL

(Steel, brass, zinc die castings, heavy zinc and lead bearing alloys)

STRIPODE

Reduces Finishing Costs to a Minimum
Reduces Stripping Time by 50% or More in Many Cases
Reduces Your Scrap Loss
Strips Plating Racks
Saves Acid

Write for information and literature

CHEMICAL CORPORATION **93 Broad Street**

SPRINGFIELD, MASSACHUSETTS

where high heat is encountered in the buffing operation. The purpose of the "Shurflow" is to furnish additional cutting power.

These two buffs are the result of developments under the direction of the company's president, Mr. Ben P. Sax. Before introduction to the industry, the above-mentioned buffs were subjected to grueling tests under actual operating conditions throughout many well known plants.

New Grease Stick and Polishing Cement

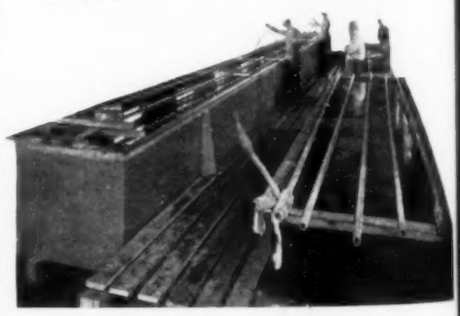
The Roberts Rouge Company, Stratford, Conn., offer two new products to the plating industry. One product is a high quality grease stick and the other is a "Jiffy" polishing cement. The manufacturer states that the polishing cement is not influenced by atmospheric conditions and sets up on the wheel better and results in a more nearly permanent head than does glue. The cement does not soften under heat nor glazes such as is the case with sodium silicate.

Sulfur-Free Rubber-Lined Tanks

Below is a photograph of a large sulfur-free, rubber-lined tank lined by Perma-Line Rubber Products Corp., 2225 West Grand Ave., Chicago, Ill.

The company is equipped for lining plating tanks of all types except chromium tanks. The sulphur-free rubber used in lining the tanks is said to be exceptionally good for bright nickel and silver plating solutions which require rubber without impurities and sulfur.

The company is seeking jobbers and invite all interested to inquire from their jobbers or directly to the above-named company.



The largest plating tank of any job shop in Chicago, coated with sulfur-free rubber.

Seeks Manufacturers of Plating Equipment and Supplies

L. M. Stone & Cia., manufacturers' agents and distributors, P. O. Box 18, Lima, Peru, seek manufacturers of plating machinery and accessories, such as anodes, buffing compositions, wire brushes, and other materials.

This company wishes to act as manufacturers' agent for plating supplies in Peru.

Metal Finishing Buyers' Directory

Metal Industry Publishing Co. Inc., 116 John Street, New York City, publishers of Metal Finishing, and Plating & Finishing Guide Book, have announced the future publication of a 1940 Buyers' Directory. The directory will list suppliers and manufacturers of all equipment, supplies, processes and chemicals used in the plating and finishing industry.

Advertisers in the directory or in any Metal Industry Publishing Company's publications will be entitled to bold faced listings in the directory.

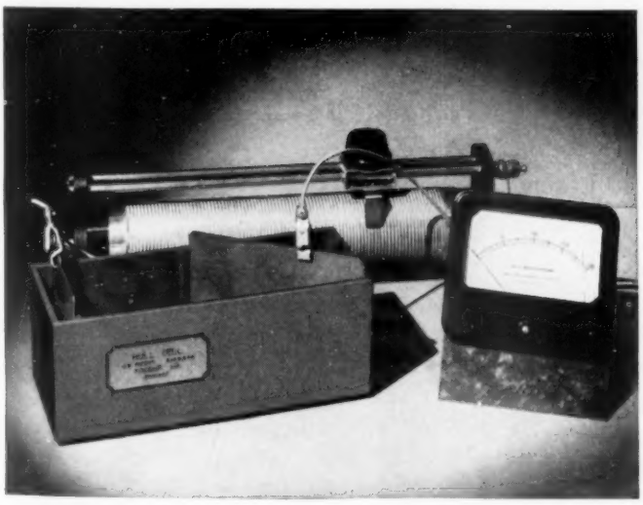
The directory will carry advertising and copy will be received until October 10th, 1940.

Hull Cell

Kocour Company, 4724 S. Christiana Ave., Chicago, Ill., have announced the sale of the "Hull Cell" which was developed by Richard O. Hull, of the DuPont Company. This cell has been found to be a most practical means for the control of solutions, especially the effect of a varying current density on the cathode, and also for the control of small quantities of addition agents to the bath.

To determine at what current density it is possible to produce the best or most economical plate, a solution is placed in the cell and a current passed through it. By adjusting the rheostat so that a predetermined current passes through the solution, the cathode will have a varying current density over its entire surface. By placing this cathode on a graph supplied with the cell, the current density which produces the best plate is determined.

The cell is made of cast aluminum, properly lined. Electrodes, wire, instructions, etc., are furnished with the cell. A source of direct current must be available; this can be furnished from a generator, rectifier, or storage battery, capable of supplying 13 to 18 volts.



Hull cell (left foreground), ammeter (right), and slide-wire resistance.

DOUBLING IN BRASS TO THE TUNE OF $200

● IN THE theater when you double in brass you do two jobs for the price of one. Wyandotte, working on a brass cleaning operation, recently saved a company the cost of more than *ten* cleaning jobs a month. Brass parts were cleaned, packed and shipped — no finishing operation.

By the old method of using an alkaline electro-cleaner on direct current with a 600-gallon tank, the work had to be racked, rinsed and dried in sawdust. . . . Cost of Alkaline Cleaner per month: $18.90.

With Wyandotte Solvent Detergent now on the job the work is placed in baskets and put in a non-conveyor-type spray washer (60-gallon capacity). After the work is rinsed it is dried with compressed air; racking and sawdust are eliminated and the cost for Wyandotte Solvent Detergent per month is only $1.54. . . . A saving of $17.36 per month, $208 per year! Your Wyandotte Representative will help you cut down *your* cleaning costs. Write today.

Wyandotte SERVICE REPRESENTATIVES IN 88 CITIES
THE J·B·FORD SALES CO· WYANDOTTE MICH·

Filter Press for Electroplating Solutions

The photograph illustrates a recently developed plate and frame pressure filter developed recently by T. Shriver & Co., 808 Hamilton St., Harrison, N. J.

The unit is complete, compact and portable and the design of the filter and the corrosion resistant construction of all parts exposed to contact with the fluid handled, make for versatility of application. The filter plates are of the company's exclusive open section, criss-cross grid design which permits rapid drainage of clear liquid and rate of discharge.

The plates and frames are of rubber covered cast iron. All piping is also rubber covered as well as the pan underneath. The Shriver diaphragm pump, which is particularly adaptable for handling corrosive slurries, has rubber covered valve chambers, expansion chamber,

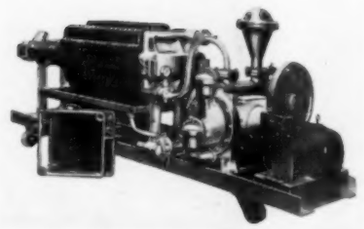
CHROMIC ACID

99.75% PURE

Stocks of Mutual Chromic Acid are available in all principal industrial centers, where Mutual distributors stand ready to give complete technical service supplemented and supported by the research and development facilities of the world's largest manufacturer of chromium chemicals.

BICHROMATE OF SODA
BICHROMATE OF POTASH

MUTUAL CHEMICAL CO. OF AMERICA
270 MADISON AVE. NEW YORK
PLANTS AT BALTIMORE AND JERSEY CITY MINES IN NEW CALEDONIA



Press for filtering plating solutions.

heads and manifolds.

The particular unit illustrated is an 18 chamber, 18" square, two eye filter with a thirty gallon per minute pump. Its filtering capacity ranges from 1,500 to 2,500 gallons per hour, depending on the nature of the fluid handled, percentage and character of the solids to be removed, and the quantity of filter aid (if used) that may be required.

Manufacturers' Literature

Drum Cradle Truck. Morse Manufacturing Co., Inc., Syracuse, N. Y. (in a recent release) describe and illustrate their drum cradle truck, which is said to offer greater safety, and ease of operation, for drum, barrel, or carboy handling.

Eye Protectors. Sellstrom Manufacturing Co., 615 N. Aberdeen St., Chicago, Ill., have issued a new 72 page catalogue describing and illustrating equipment for eye protection for those engaged in welding, polishing, grinding, or other operations demanding protection.

Grinder Dampener Bushing Cushioned Wheels. The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., of Passaic, N. J., describe the company's new vibration dampener bushing cushioned wheels, particularly, portable grinders. The wheels have a resilient mounting, placed in the center of the polishing wheel to absorb and dampen vibration.

Instruments. The Foxboro Company, Foxboro, Mass., have issued a four page folder describing uses for the company's instruments, for measuring and controlling various operations in industry. Some of the industries are: meat packing, knitting, manufacturing, hotels, etc.

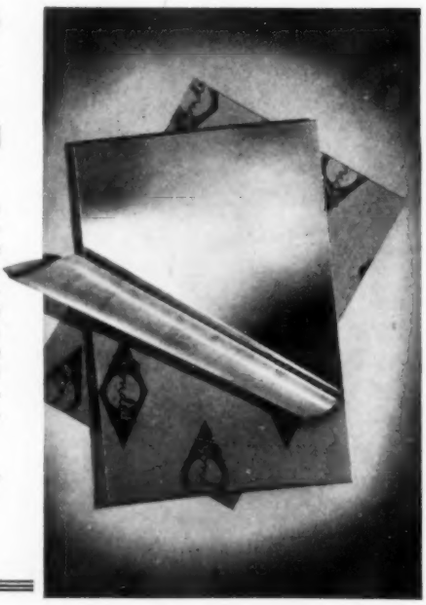
Metallizing Baby Shoes. Artco Metalizers, 5309 Wabada Ave., St. Louis, Mo., describe their metallizing service for such things as baby shoes, which can be merely metallized, or metallized and made into an ash tray, paper weight or cigarette lighter. Prices for unmounted metallizing are: $2.75 for a single shoe, and $4.50 for a pair.

WE GRAFTED

SKIN TO METAL

Paper-Adhered — an exclusive American Nickeloid development that protects the lustrous finish of American Bonded Metals during unusually severe production processes. Affords absolute protection to their mirror-like finishes from warehouse through completed fabrication . . . peels off as easily as a banana skin. A development that makes possible the production speed and economy of *pre-finished* metals despite the severity of your manufacturing process. Write on your company letterhead for illustrated brochure.

AMERICAN NICKELOID COMPANY
8 SECOND ST.—PERU, ILLINOIS
Sales Offices in All Principal Cities



Ointments. Wambaugh Chemical Co., Goshen, Ind., have issued literature describing ointments for the plating industry. Ointments for cyanides sores, nickel itch and for chromium sores are described, and prices are given for the same.

Optical Instruments. Bausch & Lomb Optical Co., Rochester, N. Y., in their Catalogue D-22 describe optical aids for the metal working industries. Described are wide field binocular microscopes, a shop microscope, a brinell microscope and an optical protractor.

Temperature Measuring Instruments. The Instrument Division of Tamms Silica Co., 228 N. LaSalle St., Chicago, Ill., have issued their bulletin No. 401, describing their pyrometers for various ranges of temperature and for multiple temperature reading.

Rotoblast Cleaning. Pangborn Corp., Hagerstown, Md., have issued two four page folders describing the economies and other advantage for their airless, blast cleaning equipment.

Potentiometer-Pyrometer. J-B-T Instruments, Inc., 441 Chapel St., New Haven, Conn., have issued a six page bulletin, describing their new portable potentiometer-pyrometer. Advantages of the company's potentiometric system are outlined. Operating information and various uses for the instrument are given.

pH Recorder. Cambridge Instrument Co. Inc., 3732 Grand Central Terminal, New York City, describe their Thermionic pH Recorder in a recent bulletin. The instrument provides a continuous record of pH with laboratory accuracy. The glass electrode is used.

Electron-Ray pH Meter. Cambridge Instrument Co. Inc., 3732 Grand Central Terminal, New York City, describe in a four page bulletin, the constructional features and advantages of their Electron-Ray pH Meter. The instrument uses the glass electrode and is said to have an overall accuracy of 0.02 pH with values from 1 to 9 pH.

Obituaries

F. P. Menninges

The St. Louis branch of the American Electroplaters' Society as well as the many friends of the late Mr. F. P. Menninges, were greatly shocked by his death in an automobile accident while returning from his vacation with Mrs. Menninges, who was also injured and is in a hospital in Litchfield, Ill.

Mr. Menninges was an active worker for the A.E.S. and was the president and secretary-treasurer of the branch for nine years and librarian for two years.

"STANDING UP FINE

AFTER 11 MONTHS"

Says

UNICHROME* RACK COATING-W

User

Another user of "Unichrome" Rack Coating W joins the enthusiastic boosters of this new, superior rack insulating material. He writes, "After 11 months use, your Unichrome Rack Coating W is still standing up fine, in both the bright nickel and chromium solutions."

Plating shops and manufacturers alike are outspoken in their approval of this better rack insulating material developed by United Chromium. For, in "Unichrome" Rack Coating W, they have found a combination of advantages not available in any other rack insulating material:

(1) Withstands boiling cleaners and all plating solutions.

(2) Tough—withstands wear and tear of handling.

(3) Contains no ingredients harmful to plating solutions.

(4) Cuts costs — reduces frequency of recoatings.

(5) Easy to apply — "dip and force dry" method.

(6) Light in color — easy to see how well the rack is covered.

(7) Any part of rack can be recoated without recoating entire rack.

Write for Bulletin 42

Containing Complete Information—

Platers without rack coating facilities may have their racks coated with "Unichrome" Rack Coating W* by Chromium Corporation of America, 4645 West Chicago Avenue, Chicago, Ill.; Belke Manufacturing Company, 947 North Cicero Avenue, Chicago, Ill.; or Lea Manufacturing Co., of Waterbury, Conn.

UNITED CHROMIUM
INCORPORATED

51 East 42nd Street, New York, N.Y.
2751 E. Jefferson Ave., Detroit, Mich.
Waterbury, Conn.

*Trade Mark
Reg. U.S. Pat. Off.

THE ROBERTS WAY

Indicates highest quality ROUGES and BUFFING COMPOUNDS always doing a first class finishing job.

Please specify your requirements and proper samples will be promptly sent at no charge.

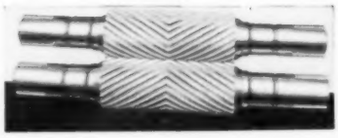
THE ROBERTS ROUGE CO.

904 Longbrook Ave. Stratford, Conn.

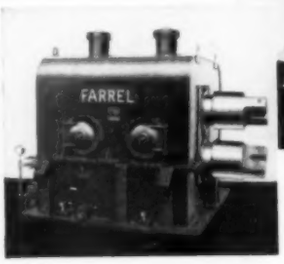
Specialists in manufacturing of thoroughly dependable gold, sterling, and silver plate rouges; stainless steel, chrome, and crocus compounds.

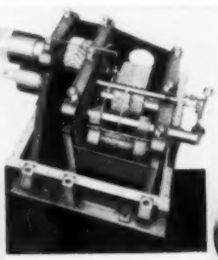
FARREL GEAR DRIVES *and* PINION STANDS

Adaptable to Individual Operating Conditions

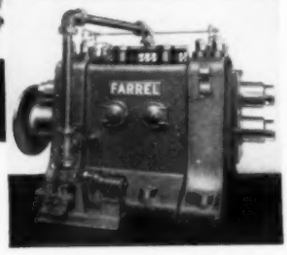


Below and Center—Two views of Double Reduction Drive and integral 20-inch Pinion Stand with welded steel case.





Above—Farrel-Sykes continuous tooth herringbone rolling mill pinions are precision generated for smooth, quiet operation.



Right—4,000 HP Pinion Stand for four-high reversing cold strip finishing mill.

Farrel Heavy Duty Rolling Mill Drives and Pinion Stands are adaptable by design and construction to individual conditions of operation. For example, the beds may be cast steel or Meehanite or welded steel construction. Dependent upon load conditions and the requirements for rigidity a double-walled or single-walled deep base may be used. Bearings may be either plain babbit-lined steel cartridges or any approved make of anti-friction bearing.

While gears and pinions are usually continuous-tooth herringbone, accurately generated by the Farrel-Sykes process, either single helical or a combination of single and double helical gears can be furnished. As conditions demand, lubrication may be by dip and splash system, by pump built into the unit and driven by one of the shafts, or by separate lubrication system.

The high precision with which Farrel Mill Drives and Pinion Stands are made assures smooth, quiet operation, and their rugged construction enables them to withstand the stresses, shocks and wear incident to the high speeds and heavy loads of modern mill practice.

When you have a gear problem call in a Farrel gear engineer for consultation.

FARREL

FARREL-BIRMINGHAM COMPANY, Inc.
ANSONIA, CONN.
New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

He was employed as superintendent of the Koken Company.

John A. Cascella

John A. Cascella, president of the Ideal Plating & Polishing Co., of 55 Branford Place, died today in Beth Israel Hospital from a heart ailment. Mr. Cascella, who was 63, lived at 401 Lake Street.

Born in Italy, Mr. Cascella came to this country 50 years ago. About 40 years ago he established the plating business and had been head of it since.

He leaves his wife, Mrs. Rose Clancia Cascella; four sons, John, Fred, Anthony and Robert; three daughters, Misses Theresa and Barra Cascella and Mrs. Pauline Caputo.

Associations and Societies

American Electroplaters' Society

Bridgeport Branch

The branch will hold its annual outing and picnic on Saturday, Sept. 14th, at Eichner's Grove, Trumbull, Conn. A buffet lunch begins at 11 A.M. and at 4:30 P.M. a chicken barbecue dinner goes on. Refreshments all day—games.

The Bridgeport branch softball team challenges the New Haven team for the outing game. (Ringers from other branches are permitted to play.)

Directions to Eichner's Grove are posted in Bridgeport at the end of East Main Street, at Beardsley Park, and at the end of Noble Ave.

Gentlemen—$2.50, Ladies—$2.00.

Come one—come all.

Newark Branch

On Sept. 7, 1940, the annual picnic of the branch will be held at Vogel's Grove, Liberty Ave., Union, N. J. Payment, $2.00 for adults; $1.00 for children. From 10:00 A.M. until 7:00 P.M.

The menu consists of: clams on the half shell; hamburgers, hot dogs, sausages, tomatoes, radishes, scallions, corn on the cob, beer and soft drink. All you want, anytime you want it, and as often as you want it.

Fall Leacrest Outing

The annual fall outing held at Bob Leather's farm, "Leacrest," at Bethlehem, Conn., will be held on Sept. 28, 1940. All engaged in the plating industry are welcome. Tariff $1.00.

Los Angeles Outing

Los Angeles Branch held its annual picnic in Recreation Park, Long Beach, Calif., on Sunday, July 28, with approximately 100 members, their families and friends in attendance. Socially, gastronomically and otherwise, the event was pronounced the most successful of the various outings the chapter has sponsored in recent years.

To get themselves in shape for an afternoon of foot races, tugs-of-war and egg-tossing contests, the picnickers partook of an al fresco lunch at high noon as the first order of business. The lunches were spread on long wooden tables set up under tall eucalyptus trees, and, paired off in family groups, the picnickers dove in gustily, with coffee supplied by the chairman of the Java Committee, *Bruno H. Schindler.*

The afternoon was devoted to foot races and various contests which were participated in by young and old. Winners of the various events were:

50-yard dash for women: *Eleanor Oliphant,* first; *Bernadotte Regmunt,* second.

Three-legged race for men: *W. Oliphant* and *L. Belger,* first; *Eugene Rynkofs* and *Jack Sloan,* second.

The backwards race for men was participated in by *Bruno Schindler, Don Bedwell, Herold J. Kroesche, Emmette R. Holman, L. Belger* and *Erv Frauenhof.* Belger emerged winner, principally because the rest of the field were lying on

their respective ears before the race was half finished.

Participants in the Egg-Tossing Contest were Messrs. and Mesdames *Schindler, McLaren, Frauenhof, Bedwell, Merigold, Vasquez, Holman, Myberger, Extale* and *King*. Unbekownst to the participants half of the eggs were hardboiled and half were fresh. Winning couple was Mr. and Mrs. *Carl McLaren* who were still tossing the yolk of their egg back and forth when all other contestants had been eliminated through dropping their eggs.

Arrangements for the outing were made by the same committee which handled preparations for the 1939 gathering in City Park, Montebelo, Calif.

Personals

Derick S. Hartshorn, Jr. Becomes Technical Director of Enthone Company

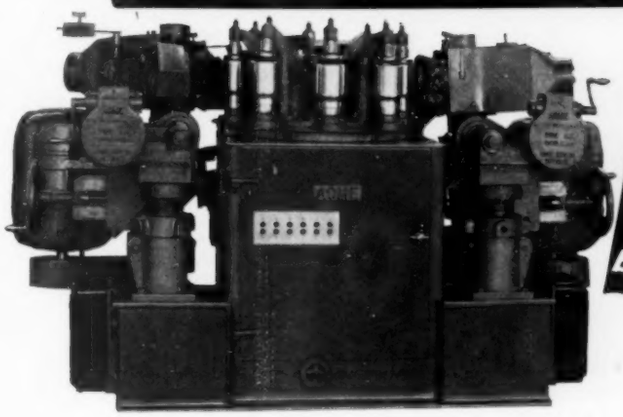
J. F. Buckman, President of the Enthone Company, New Haven, Connecticut, has announced the appointment of *Derick S. Hartshorn, Jr.* as Technical Director of the Enthone Company. He will supervise development of new products, and also do Sales Engineering work.

Mr. Hartshorn received his technical training at the University of North Carolina, and for the past seven years has been associated as chemist with Westinghouse Electric & Manufacturing Company, East Springfield, Massachusetts. He is well known in the plating and finishing field for numerous papers which he has presented at national and local meetings.

In 1938 he presented a prize winning paper on copper plating at Milwaukee. Mr. Hartshorn is also director of the New England Control Laboratories, and the facilities of these laboratories will be merged with those of the Enthone Company. Mr. Hartshorn is a member of the American Electroplaters' Society, the Electrodepositors' Technical Society of England, and the Electrochemical Society.

D. S. Hartshorn, Jr.

WHY NOT DO YOUR *Polishing and Buffing* FASTER AND CHEAPER?



Acme THREE WHEEL ROTARY AUTOMATIC

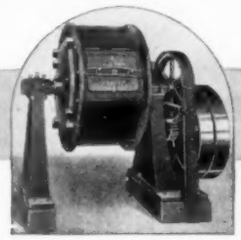
SEND SAMPLE for FREE Production Estimate

Where speed is a factor in polishing and buffing, or where the problem is one of reducing production costs, Acme Automatics have a definite place.

Consider, for example, the Three-wheel Rotary Automatic, illustrated above—a heavy duty machine designed principally for cylindrical work. It does its job with a rapidity that is almost unbelievable. And, at the same time, it produces a better finish than can be obtained by any other method.

Bring your polishing or buffing problem to Acme! It may surprise you to find how easily one of the many types of Acme Automatics can be adapted to your particular needs, speeding up production and materially reducing costs.

ACME *Manufacturing Co.*
1642 HOWARD ST. • DETROIT, MICH.
Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS



Barrel Finishing

earns profits 3 ways

1 Work hardens the surface of small metal parts, increasing wear resistance.

2 Closes the pores in the metal, increasing resistance to corrosion.

3 Produces brilliant finish on plated and unplated parts.

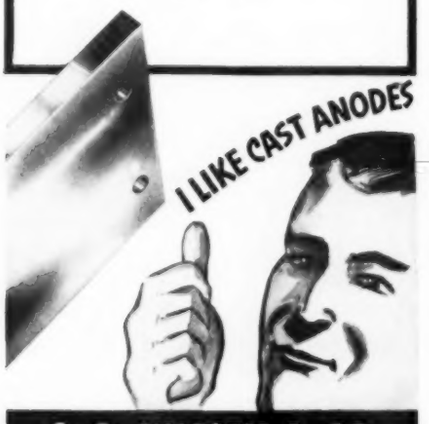
Write today for complete information

The Abbott Ball Company
1046 New Britain Ave. Hartford, Conn.

HUSSEY

Produces
PURE COPPER
ANODES
CAST or ROLLED

Whatever your preference may be . . . cast or rolled copper anodes . . . you can be certain of uniform, quick depositing with Hussey Anodes. Available in any size or shape, directly from your nearby Hussey Warehouse.



C. G. HUSSEY & CO.
(Division of Copper Range Co.)
Rolling Mills & General Offices: Pittsburgh, Pa.
Warehouses in Principal Cities

Joe Barron Heads 1941 Boston A.E.S. Convention

Joe Barron

Richard Crane

Richard Crane, popular salesman of Lea Mfg. Co., Waterbury, Conn., was honored at the annual convention of the American Electroplaters' Society, held at Dayton, Ohio, by unanimous election to the vice-chairmanship of the International Fellowship Club.

Largest Plating Tank in any Chicago job shop

LARGE TANKS LIKE THIS

BOTH BIG AND SMALL PLATING TANKS OF ALL TYPES

LINED WITH PERMA-LINE RUBBER

Sulfur free and particularly adapted to bright nickel and silver plating.

PERMA-LINE RUBBER PRODUCTS CORP.
2225 W. Grand Ave. Chicago, Ill.

THE WILLIAMSVILLE BUFF MFG. CO. TRADE EST. A1 1893 MARK DANIELSON CONN.

"A1"

MAGIC letters are these in Dun and Bradstreet, and they're equally assuring on a buff wheel. Since 1893 our buffs have been known by the A1 trademark, assurance of quality and workmanship.

BUY WILLIAMSVILLE BUFFS

Former I. T. & T. Engineer Joins Green Electric Co.

W. Green Electric Co. Inc., 192 Broadway, New York, announce the addition to their staff of *Louis W. Reinken*, electrical engineer, formerly of the International Telephone Development Co. who recently returned to the United States after eight years abroad, where he had been engaged in supervising the promotion of selenium rectifiers in England, France, Belgium, Sweden, Denmark, Norway, Spain, Portugal, Hungary, Switzerland, Italy and the Balkan nations. Mr. Reinken was one of the pioneers in the introduction of the selenium rectifier and his long experience has given him an unequalled

Louis W. Reinken

first hand experience with this type equipment.

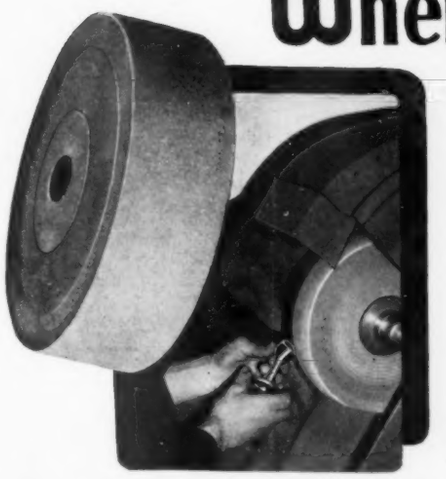
The International Telephone Development Co. recently introduced the selenium rectifier in the United States after ten years of successful experience in other countries and recalled Mr. Reinken to utilize his experience for the American promotion.

W. Green Electric Co. was the first organization in the United States to appreciate the unique advantages of selenium rectifiers for electroplating. Consequently they developed a line of light, medium and heavy duty rectifiers under the registered trade name, Selectro-Plater incorporating the American made rectifier unit which uses the selenium stack. The Selectro-Plater has already gained wide acceptance as a source of low voltage current.

With the addition of Mr. Reinken to their staff, W. Green Electric Co. are in a position to deal with any current supply problem in the electroplating field.

Theodore F. Onkey, President of the *Roberts Rouge Co.*, Stratford, Conn., has just returned from a ten days Canadian business trip and reports a marked increase in business volume from Canadian sources. Mr. Onkey was much impressed

When BEST it's FELT



Companies that make their product look worth the difference to the buyer use *Paramount Brand* Felt Polishing Wheels to polish the base metal, knowing that to have the best finish, you must start right, which means, *Paramount* Felt Polishing Wheels.

Ask Your Supplies Salesman for PARAMOUNT BRAND

BACON FELT CO. WINCHESTER MASS. ESTABLISHED 1824

IS THE DAY TOO SHORT?

SAVE TIME BY SENDING YOUR SOLUTIONS TO US FOR ANALYSIS. IMMEDIATE ACCURATE REPORT BY AIR MAIL.

NICKEL SOLUTIONS
Nickel, Chlorides
Boric Acid, pH
COPPER SOLUTIONS
Copper, Free Cyanide
Carbonates, pH
ACID COPPER
Copper, Sulfuric Acid

$1

ROCHELLE COPPER
Copper, Rochelle salts
Free Cyanide, Carbonate
pH
BRASS SOLUTION
Copper, Zinc, pH
Free Cyanide, Carbonate

$1.50

Other Solutions & Other Ingredients At Equally Low Prices
Send a 4 oz. Bottle by Parcel Post or Prepaid Express

KOCOUR CO.
4720 S. CHRISTIANA AVE.
CHICAGO

★ ★ ★ SPECIALISTS IN SOLUTION CONTROL ★ ★ ★

For a Wider Range of Oxidized Finishes

use

McKEON'S

"Liquid Sulphur"
TRADE MARK REG'D

"The Oxidizing Agent of Today"

EFFICIENT — ECONOMICAL — EASY TO USE

SULPHUR PRODUCTS CO.
Greensburg, Pa.

Let's boost Boston's A. E. S. Convention June 9-10-11-12

by the high morale of the Canadian citizens and by their attitude toward war, as well as the friendly feeling toward American visitors and business interests.

New Periodical on Metal Spraying

Metallizing Engineering Co., Inc., manufacturers of Metco Metallizing Equipment, announces the first issue of METCO NEWS—a periodical devoted entirely to the latest developments and applications of the metal spraying process. All those actively engaged in the maintenance, salvaging or manufacture of metal products or equipment may receive this and ensuing issues, without cost, by writing to the publishers at 21-07 41st Avenue, Long Island City, New York.

COURSES IN ELECTROPLATING

The Institute of Electrochemistry and Metallurgy, 59-61 East Fourth Street, New York City, will offer specialized courses in the field of electroplating and metallurgy during 1940-41. Registration will be held for the Fall term from September 10th to September 17th. Registration will be held for the Spring courses from February 6th to February 10th inclusive and the first class meeting will occur on February 7th. The following studies will be offered:

FALL COURSES

Electroplating I.

The course is designed to give the electroplater or industrial worker a foundation in chemistry including qualitative and quantitative analysis. One hour each evening will be devoted to class lectures in which will be discussed the theories of modern chemistry as applied to electroplating. The remaining hours will be devoted to the laboratory where the student will conduct his own experiments. Tuesday and Wednesday from 7:30 to 11:00 P. M. Dr. Young and Mr. Klinsevich. Fee, $45.00.

Metallurgy I.

The student will be introduced to the structure of metals and alloys and factors are taken into account which affect these, such as temperature, mechanical working, etc. The application of the phase rule to physical metallurgy will be discussed. Both binary and tertiary systems will be studied and illustrated. Heat treating, surface treating and testing of metals and alloys will be studied. Tuesday and Wednesday, 8:30-9:30 P. M. Dr. Young and Mr. Klinsevich. Fee, $30.00.

Research I.

This course is designed to give the practical electrochemist a chance to investigate problems in his field. One half hour per week is devoted to a conference with the instructor in which the method of attack is laid out. The remaining time is spent in the laboratory where the student applies his knowledge and technique to the solving of problems which arise in such an investigation. Tuesday and Wednesday, 7:00-11:00 P. M. Dr. Young. Fee, $30.00.

Industrial Microscopy IA.

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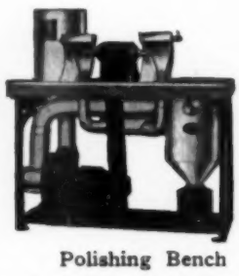
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Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.175
Butyl-normal, l.c.l., drums	lb.	.095
Denat., S.D. #1, 190 pf., 1-18 drms, wks.	gal.	.335
Diacetone, pure, drums, l.c.l.	lb.	.10
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.36
Propyl-Iso, 99%, l.c.l., drums	gal.	.41
Propyl-Normal, drums	gal.	.70
Alum, ammonia, granular, bbls., works	lb.	.035
Potash, granular, bbls., works	lb.	.0375
Ammonia, aqua, 26°, drums, carboys	lb.	.02½-.05¼
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Sulphate, tech., bbls.	lb.	.035-.05
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Sulphocyanide (thiocyanate), com'l, drums	lb.	"
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Carbon Tetrachloride, l.c.l., drums	gal.	.73
Chrome, green, commercial, bbls.	lb.	.21
Chromic Sulphate, drums	lb.	.26¼
Cobalt Sulphate, drums	lb.	.65
*Copper, Acetate (verdigris), bbls.	lb.	.25
Carbonate, 53/55%, bbls.	lb.	.16
Cyanide, Tech., 100 lb. bbls.	lb.	.34
Sulphate, Tech., crystals, bbls.	lb.	.051
Cream of Tartar (potassium bitartrate), gran., bbls.	lb.	.34¾
Crocus Martis (iron oxide) red, tech., kegs	lb.	.07
Dibutyl Phthalate, l.c.l., drums	lb.	.195
Diethylene Glycol, l.c.l., drums, works	lb.	.155
Dextrine, yellow, kegs	lb.	.05-.08
Emery Flour (Turkish)	lb.	.07
Ethyl Acetate, 85%, l.c.l., drums, works	lb.	.075
Ethylene Glycol, l.c.l., drums, works	lb.	.17-.20
Flint, powdered	ton	30.00
Fluorspar No. 1 ground, 97-98%	ton	$60.00
Fusel Oil, refined, drums	lb.	.125-.14
*Gold, Chloride	oz.	$18¼-23
Cyanide, potassium 41%	oz.	$15.45
Cyanide, sodium 46%	oz.	$17.10
Gum, Arabic, white, powder, bbls.	lb.	.125-.14
Sandarac, prime, bags	lb.	.50
Hydrogen Peroxide, 100 volume, carboys	lb.	.20
Iron Sulphate (Copperas), bbls.	lb.	.017
Lead, Acetate (Sugar of Lead), bbls.	lb.	.11-.13¾
Oxide (Litharge), bbls.	lb.	.125
Magnesium Sulphate (Epsom Salts), tech., bag	lb.	.018
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Mercuric Oxide, red, powder, drums	lb.	$3.36
Nickel, Carbonate, dry, bbls.	lb.	.36-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.135-.145
Salts, double, 425 lb. bbls.	lb.	.135-.145
Paraffin	lb.	.05-.06
Perchlorethylene, drums	lb.	.08½
Phosphorus, red, cases	lb.	.42
yellow, cases	lb.	.40
Potash, Caustic, 88-92%, flake, drums, works	lb.	.07¼-.075
Potassium, Bichromate, crystals, casks	lb.	.09¼
Carbonate (potash) 98-100%, drums	lb.	.06¾
Cyanide, 94-96%, cases	lb.	scarce
Pumice, ground, bbls.	lb.	.03
Quartz, powdered	ton	$30.00
Quicksilver (Mercury), 76 lb. flasks	flask	$196.
Rochelle Salts, crystals, bbls.	lb.	.25¼
Rosin, gum, bbls.	lb.	5.25-7.75
*Silver, Chloride, dry, 100 oz. lots	oz.	.32
Cyanide, 100 oz. lots	oz.	.33½
Nitrate, 100 oz. lots	oz.	.27
Sodium, Carbonate (soda ash), 58%, bbls.	lb.	.0235
Cyanide 96%, 100 lb. drums	lb.	.15
Hydroxide (caustic soda) 76%, flake	lb.	.0355
Hyposulphite, crystals, bbls.	lb.	.035-.065
Metasilicate, granular, bbls.	lb.	.0335
Nitrate, tech., bbls.	lb.	.029
Phosphate, tribasic, tech., bbls.	lb.	.0295
Pyrophosphate, anhydrous, bbls., l.c.l.	lb.	.0580
Sesquisilicate, drums	lb.	.0425
*Stannate, drums	lb.	.35-.38
Sulphate (Glauber's Salts), crystals, bbls., works	lb.	.0135
Sulphocyanide, drums	lb.	.30-.35
Sulphur, Flowers, bbls., works	lb.	.037-.0410
*Tin Chloride, 100 lb. kegs	lb.	.39½
Toluene (Toluol), pure, drums, works	gal.	.32
Trichlorethylene, drums	lb.	.08½
Tripoli, powdered	lb.	.03
Wax, Bees, white, bleached, slabs 500 lbs.	lb.	.36-.40
Bees, yellow, crude	lb.	.24-.28½
Carnauba, refined, bags	lb.	.55-.60
Montan, bags	lb.	.27½-.30
Spermaceti, blocks	lb.	.24-.27
Whiting, Bolted	lb.	.025-.06
Xylene (Xylol), drums, works	gal.	.31
Zinc, carbonate, bbls.	lb.	.13½-.16
Cyanide, 100 lb. kegs	lb.	.33
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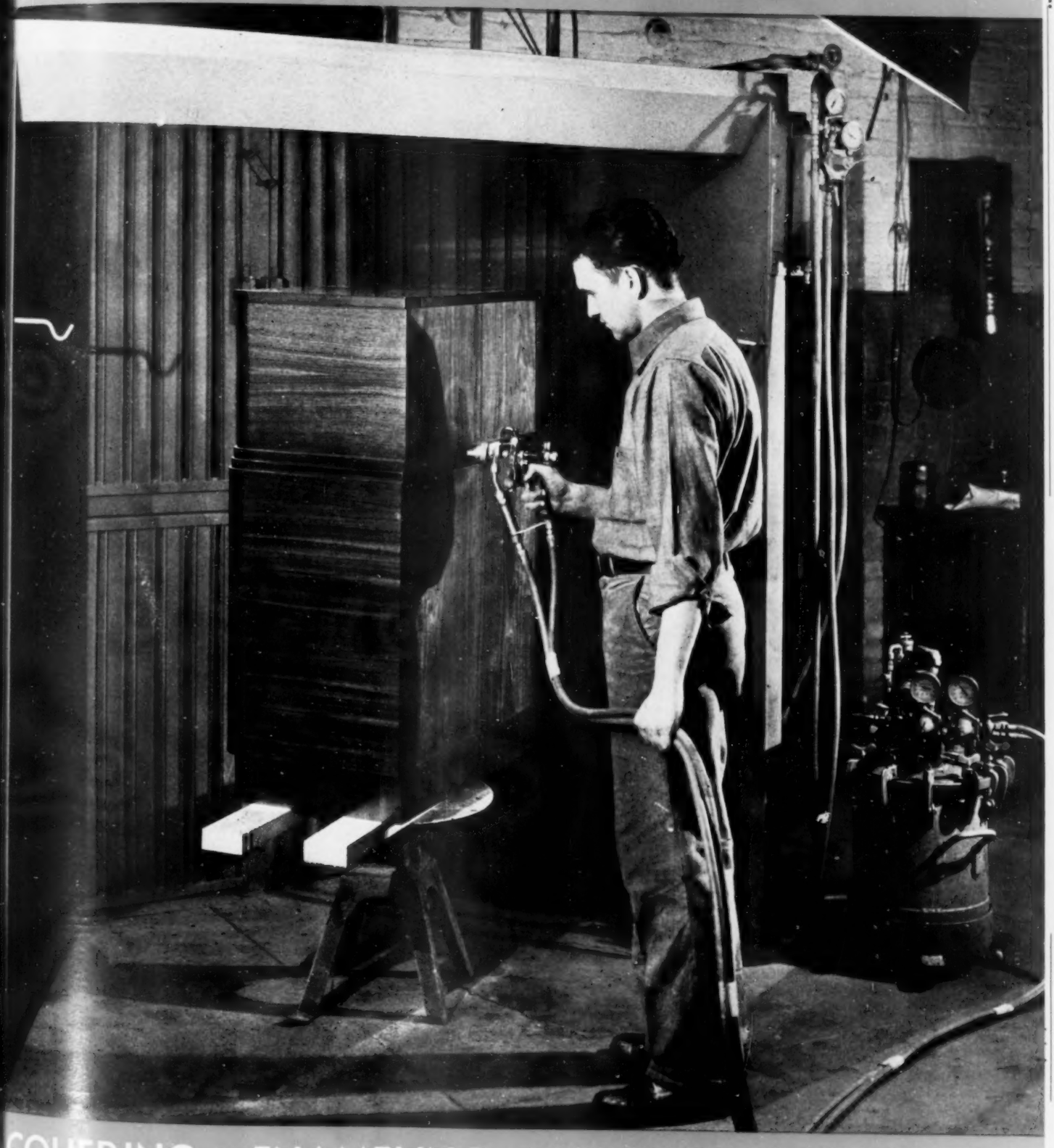

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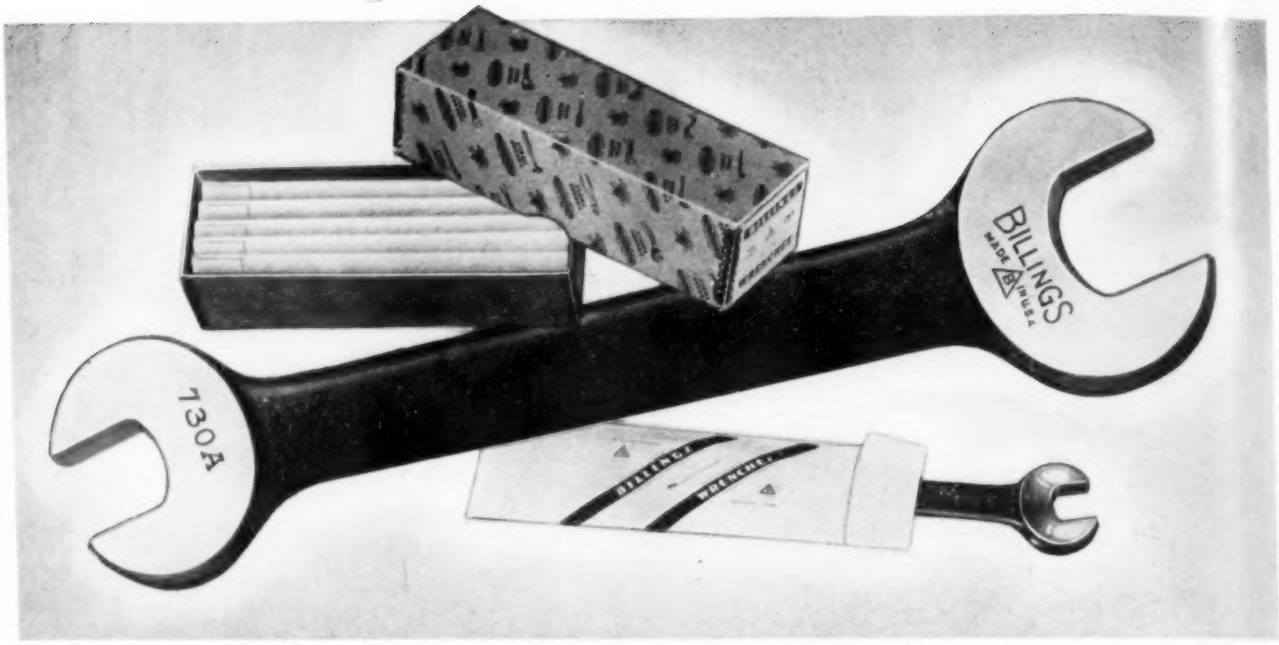

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ORGANIC FINISHING

SECTION OF METAL FINISHING

SEPTEMBER, 1940

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PICTURE ON COVER
(Courtesy Binks Mfg. Co., Chicago, Ill.)

The Thickness of Organic Coatings

The degree to which an organic finishing material serves its purpose as a protective coating under any given set of conditions depends on a number of factors. Among these are: the type of material and its particular combination of ingredients, the proper preparation of the material for use, the type and condition of the surface on which the material is applied, and the correct processing of the material after application.

There is, however, still another factor which, because of its great importance, deserves special consideration, namely, the thickness of the film of finishing material. It is obvious that an otherwise perfectly satisfactory finishing material, correctly chosen as to type and properly prepared, applied and processed, may fail miserably in service if the film is not of sufficient thickness. Failure may also result if the film is overly heavy.

The importance of film thickness demands that it be recognized both in the evaluation and the actual use of finishing materials. In tests, the film thickness used should be carefully recorded along with the other testing conditions and data. In production, the film thickness should be checked constantly to determine if the specifications based on tests are being fulfilled. Such measures are good insurance against finish failures and excessive material costs.

L. J. LANGDON, *Publisher* • T. A. TRUMBOUR, *Business Manager* • DR. WALTER R. MEYER, *Editor*

Surface Treatment of Steel Prior to Painting*

By Rolla E. Pollard and Wilbur C. Porter

A number of surface-treatment processes are described for both plain and galvanized steel. Among such treatments subjected to accelerated weathering, salt spray, and condensation corrosion tests, the hot-dip phosphate treatments for both plain and galvanized surfaces showed outstanding merit in improving the protective value of paints. Particularly effective protection was obtained when such treatments were used, under severely corrosive conditions, in combination with a primer of the inhibitive type. A phosphate cold wash for galvanized steel and two phosphate-chromate cold-wash treatments for plain steel also appeared to improve paint protection.

I. INTRODUCTION

The increasing use of sheet steel as a structural building material serves to emphasize the need of improved methods for prolonging the life of the material by suitable surface treatment. During the past 2 years the National Bureau of Standards has been investigating this subject as part of a general research program on building materials for low-cost house construction. In a previous publication, report BMS8, Methods of Investigation of Surface Treatment for Corrosion Protection of Steel, the testing program was outlined, the testing methods were described, and the pretreatment processes and paints being tested were listed. The testing program consisted of a number of accelerated laboratory corrosion tests applied to painted panels of plain and galvanized sheet steel, supplemented by outdoor exposure tests of similar materials at Washington, D. C.

Sufficient time has not elapsed as yet for the outdoor exposure tests to produce significant results. The condensation corrosion tests also have been rather slow, results to date being limited largely to paints applied to untreated galvanized-steel panels. However, results have been obtained in a shorter time from the salt-spray and accelerated-weathering tests, and a considerable amount of useful information has been accumulated. It is believed that some of these results may be discussed with profit if comparisons are limited to the tests themselves and conclusions are drawn on the basis of factors affected by conditions peculiar to the individual test.

II. SCOPE

One of the chief objectives of the investigation has been to study the various methods used in attempting to improve the protective value of paints applied to steel. One such method is to treat the surface prior to painting, in order to provide an improved base for the paint; another method is to improve the paint itself. The present report will be concerned chiefly with the first, or pretreatment, method of improvement. This report is limited to the description of the pretreatment processes tested, and to the discussion of the relative merits of such processes as measured by the protective value of paints subsequently applied and then tested in the salt-spray cabinet, accelerated-weathering machine, and condensation corrosion cabinet. Some of the factors affecting the protective value of the paints themselves will be considered in a later publication.

The panels used in tests of the pretreatment processes covered by the present report were of plain hot-rolled annealed sheet steel or of hot-dip zinc-coated (galvanized) sheet steel.

III. PRETREATMENTS FOR GALVANIZED-STEEL SURFACES

The object of pretreating galvanized steel is to improve the surface for painting. For example, paint adherence can be improved by roughening the surface mechanically or chemically or by the deposition of a film, preferably nonmetallic, which improves the bond between paint and metal. It is desirable that the film formed should be one that prevents reaction between the zinc and the paint vehicle and retards corrosion by reason of its insolubility, its inhibitive action, or its reaction with corrosion products to form an insoluble film.

The following pretreatment processes for galvanized steel, designed to effect some of these improvements, were included in the testing program:

LIST 1.—*Pretreatment processes for galvanized steel.*

A. Untreated hot-dip galvanized surface.

B. Proprietary phosphate treatment. Cold wash in aqueous zinc-phosphate solution containing free phosphoric acid and an activating agent.

C. Etching solution. Water containing 8 oz. of copper sulfate per gallon.

D. Etching solution. Water containing 8 oz. of zinc sulfate per gallon.

E. Etching solution. Alcohol, 60; toluol, 30; carbon tetrachloride, 5; and hydrochloric acid, 5; parts by volume.

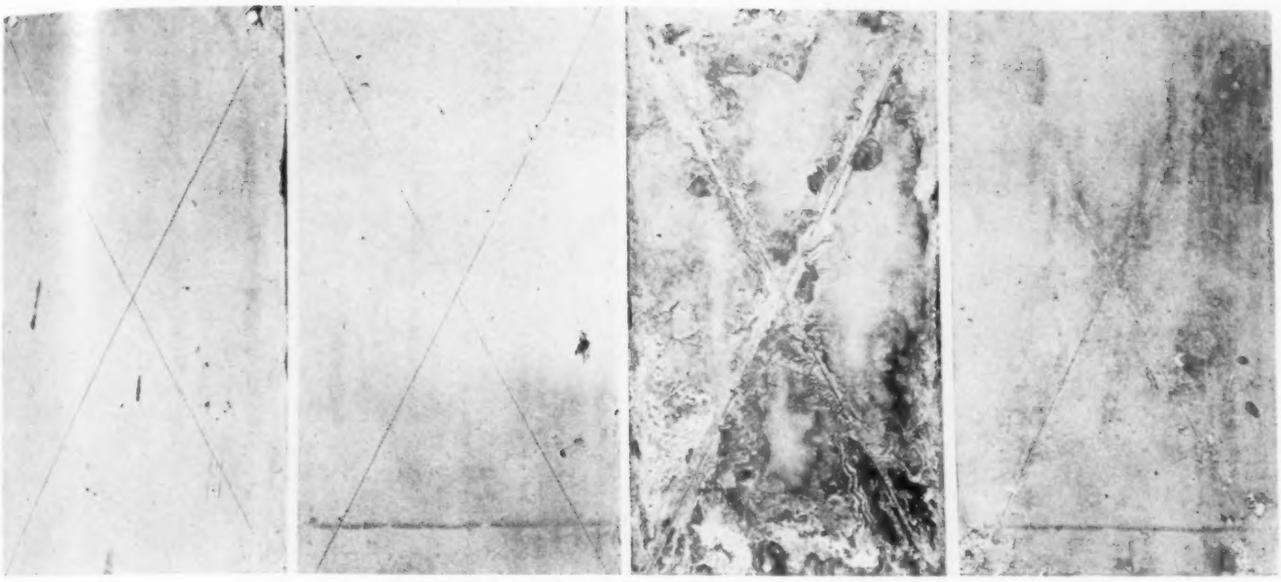
F. Etching solution. Saturated aqueous solution of nickel sulfate, 10 parts by weight, antimony-potassium tartrate, 0.5 part by weight, neutralized with ammonium hydroxide, made slightly acid with hydrochloric acid, and then diluted to 100 parts by weight with water.

G. Etching solution. Alcohol, 4; phosphoric acid (85 percent), 1; part by volume.

H. Proprietary phosphate treatment. Hot dip in aqueous zinc-phosphate solution containing free phosphoric acid and an activating agent.

I. Laboratory etching solution. Dilute acetic acid, 4 percent

* This is a reprint of Report BMS41 of the National Bureau of Standards.



Panel J-8 *Panel B-8* *Panel E-8* *Panel A-8*

Figure 1.—*Comparison of salt-spray tests of hot-dip galvanized-steel panels subjected to surface treatments J, B, E, and A prior to painting with two coats of primer 8.*

Panel J-8: Hot-dip phosphate treatment (J); salt spray, 365 days' exposure.
Panel B-8: Cold-wash phosphate treatment (B); salt spray, 104 days' exposure.
Panel E-8: Alcohol-toluol-acid treatment (E); salt spray, 123 days' exposure.
Panel A-8: Untreated galvanized surface (A); salt spray, 104 days' exposure.
(Panels as shown are approximately two-thirds actual size.)

by volume.

J. Proprietary phosphate treatment. Hot dip in aqueous zinc-phosphate solution containing free phosphoric acid and an activating agent.

K. Proprietary oxalate-phosphate treatment. Hot dip in an aqueous solution containing an oxalate and phosphoric acid.

L. Proprietary dichromate treatment. Cold immersion in a sodium-dichromate aqueous solution containing sulfuric acid.

IV. PRETREATMENTS FOR PLAIN-STEEL SURFACES

The adherence of paint to a clean, dry steel surface is generally very good. An important objective to be sought in any pretreatment process, therefore, is to obtain a clean, dry surface free of rust and loose scale, or to deposit a film having equal or superior adherence, which will prevent or retard corrosion underneath the paint.

The following pretreatment processes, which were applied to plain sheet steel for the purpose of attaining some of these objectives, were included in the testing program:

LIST 2.—*Pretreatment processes for plain-steel surfaces.*

Fe. No treatment. Painted over mill scale.

Fe-A. Pickled in hot aqueous solution of hydrochloric acid (20-percent concentrated acid by volume).

Fe-B. Proprietary phosphate treatment. Hot dip in an aqueous zinc-phosphate solution containing free phosphoric acid and an activating agent.

Fe-C. Proprietary chromate treatment. Hot dip in an aqueous chromic-acid solution containing activating agents.

Fe-D. Proprietary phosphate-chromate treatment. Cold wash in an aqueous solution containing phosphoric acid, phosphates, and chromates.

Fe-E. Proprietary phosphate-chromate treatment. Cold wash in an aqueous solution containing phosphoric acid, phosphates, and chromates—generally used with an inhibitive primer.

Fe-H. Proprietary phosphate treatment. Hot dip in an aqueous zinc-phosphate solution containing free phosphoric acid and an activating agent.

Fe-K. Proprietary oxalate-phosphate treatment. Hot dip in an aqueous solution containing an oxalate and phosphoric acid.

Fe-M. Proprietary phosphate treatment. Cold wash in an aqueous solution of phosphoric acid containing a wetting agent.

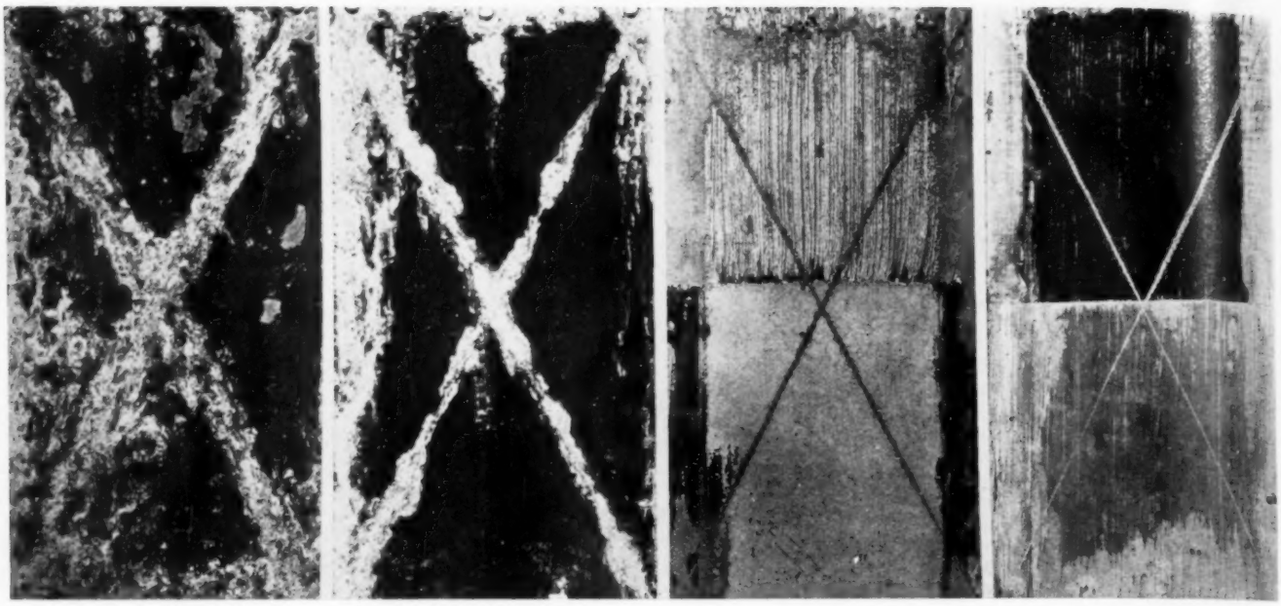
Fe-P. Pickled in hot aqueous solution of phosphoric acid (10-percent sirupy acid by volume).

Fe-S. Pickled in hot aqueous solution of sulfuric acid (20-percent concentrated acid by volume).

V. METHODS OF TESTING

After pretreatment, the plain-steel or galvanized-steel panels were brushed, as a rule, with two coats of primer, a week being allowed for drying between application of coats. One half of the surface of each panel was then given a top coat of outside finish paint. Most of the painted panels were scratched diagonally before being tested. All panels were 3 by 6 inches except those for the condensation cabinet, which were 5 by 7 inches.

Galvanized-steel panels are identified in this report by letters representing the surface treatments given in list 1. For the plain-steel panels the letters are preceded by the symbol *Fe*, as shown in list 2. Following each letter is a number identifying the primer with which the panel is painted. For



Panel A-1 *Panel L-1* *Panel A-1-w* *Panel L-1-w*

Figure 2.—*Comparison of salt-spray and accelerated-weathering tests on galvanized steel panels subjected to acid-dichromate treatment L prior to painting.*

Panel A-1: Untreated galvanized surface (A), two coats primer 1; salt spray, 28 days' exposure.
Panel L-1: Acid-dichromate treatment (L), two coats primer 1; salt spray, 61 days' exposure.
Panel A-1-w.:Untreated galvanized surface (A), two coats primer 1 white top coat upper half; accelerated weathering, 8 months' exposure.
Panel L-1-w: Acid-dichromate treatment (L), two coats primer 1 black top coat upper half; accelerated weathering, 6 months' exposure.
(Panels as shown are approximately two-thirds actual size.)

example, designation *A-1* represents an untreated galvanized-steel panel coated with primer 1 out of a group of some 80 primers and paints. Similarly, panel *Fe-A-1* represents a plain-steel sample pickled in hot hydrochloric acid and coated with primer 1.

Panels representing all the pretreatment processes listed above for galvanized-steel surfaces have been tested by salt spray and by accelerated weathering. A number have also been tested in the condensation corrosion cabinet. Tests of plain-steel panels have been more limited but include salt-spray and accelerated-weathering tests of samples representing all the pretreatment processes listed.

VI. RESULTS OF TESTS

1. Salt Spray

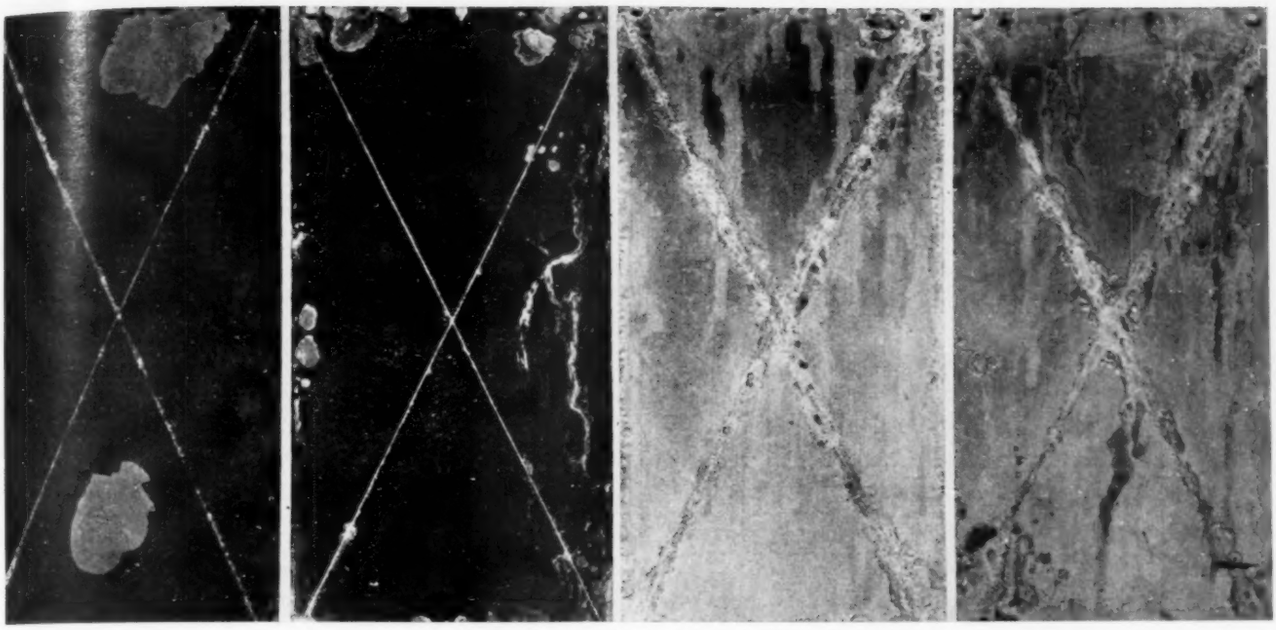
The salt-spray test as used in this work consisted in the continuous exposure of painted panels to the fine mist or spray produced by "atomizing" a 20-percent aqueous solution of sodium chloride at 35° C.

The principal factors which accelerate breakdown of paint on galvanized steel in this test seem to be moisture penetration and action of the chloride ion. The moisture, of course, causes corrosion of the metal and promotes reaction between metal and paint or between corrosion product and paint. These reactions probably are accelerated by the chloride ion. The paints which would be expected to stand up best in the salt spray are those which resist moisture penetration or those which contain an inhibitive pigment, such as zinc chromate.

The pretreatments for galvanized-steel surfaces which gave the greatest improvement to the protective value of paints subjected to salt-spray tests were the hot-dip phosphate treatments *H* and *J*. These treatments appeared to be about equal in value and were definitely superior to all others tested. A panel which was given treatment *J* and then covered with primer 8 is shown in *J-8* of figure 1. The surface of the panel was in essentially perfect condition after 365 days in the salt spray. The phosphate cold-wash treatment *B* was found to be slightly inferior to the hot-dip treatments. Panel *B-8*, as shown in figure 1, was still in excellent condition after 104 days in the spray. The acid-dichromate treatment *L*, probably because of its inhibitive action, also gave very good results in this test and was in many cases, almost equal to treatments *H* and *J*. As will be shown later, however, this treatment has some disadvantages in other tests and, therefore, is considered separately. The two left-hand panels in figure 2 show the relative protective value of paint 1, after testing in the salt spray, when applied to an untreated galvanized surface (panel *A-1*) and when applied over treatment *L* (panel *L-1*). It will be noted that panel *L-1* was in much better condition than panel *A-1* after exposures of 61 and 28 days, respectively.

The other pretreatments listed for galvanized-steel surfaces were found to be of questionable value for the improvement of the protective value of paints in the salt-spray test. Treatment *K*, for example, appeared to improve or, rather, prolong the protective value of some of the inhibitive primers but not of other types. In figure 3 the two left-hand panels show the marked improvement obtained with inhibitive primer 5 applied over treatment *K* (panel *K-5*) as compared with the same primer applied to an untreated galvanized surface (panel *A-5*). With noninhibitive primer 6 no improvement was obtained, as shown by panels *A-6* and *K-6*.

Treatments *C*, *D*, *E*, *F*, *G*, and *I*, classed together as etching solutions, gave no evidence of improvement over comparison panels of untreated material. An example of treatment *E* of



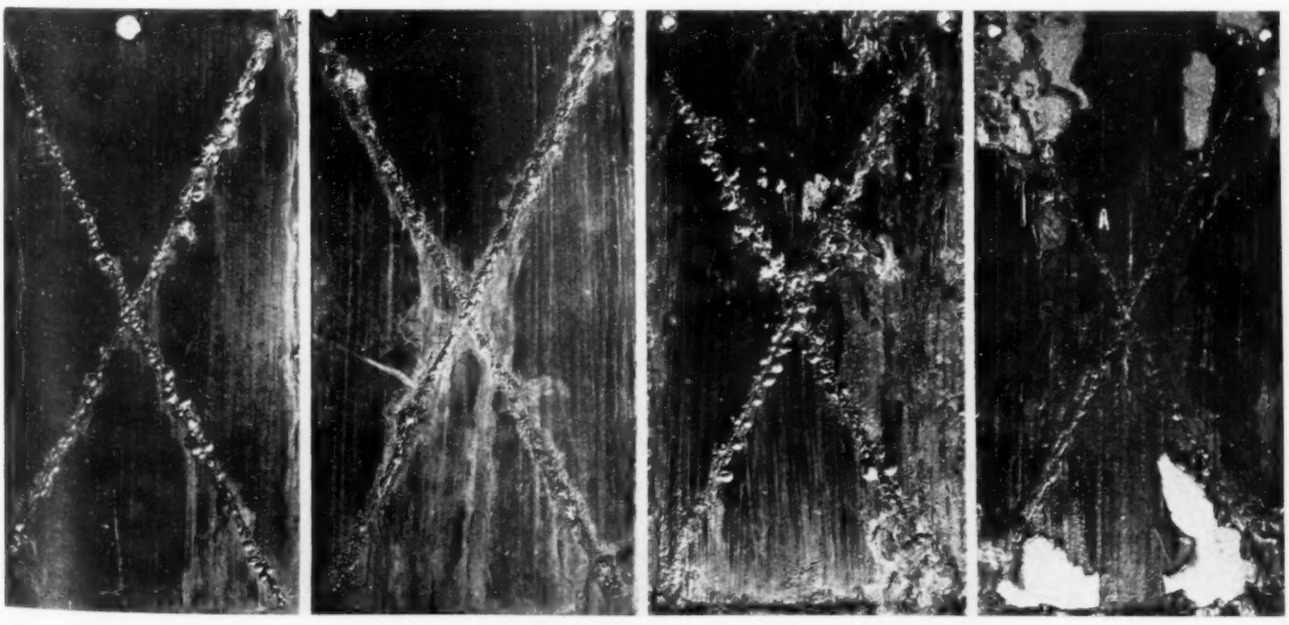
Panel A-5 *Panel K-5* *Panel A-6* *Panel K-6*

Figure 3.—*Comparison of salt-spray tests of different types of paints on galvanized-steel panels subjected to oxalate-phosphate treatment (K) prior to painting.*

Panel A-5: Untreated galvanized surface (A), inhibitive primer 5; salt spray, 104 days' exposure.
Panel K-5: Oxalate-phosphate treatment (K), inhibitive primer 5; salt spray, 231 days' exposure.
Panel A-6: Untreated galvanized surface (A), noninhibitive primer 6; salt spray, 70 days' exposure.
Panel K-6: Oxalate-phosphate treatment (K), noninhibitive primer 6; salt spray, 74 days' exposure.
(Panels as shown are approximately two-thirds actual size.)

this group is shown in panel *E-8* of figure 1 in comparison with the untreated panel *A-8* after exposures of 123 days and 104 days, respectively.

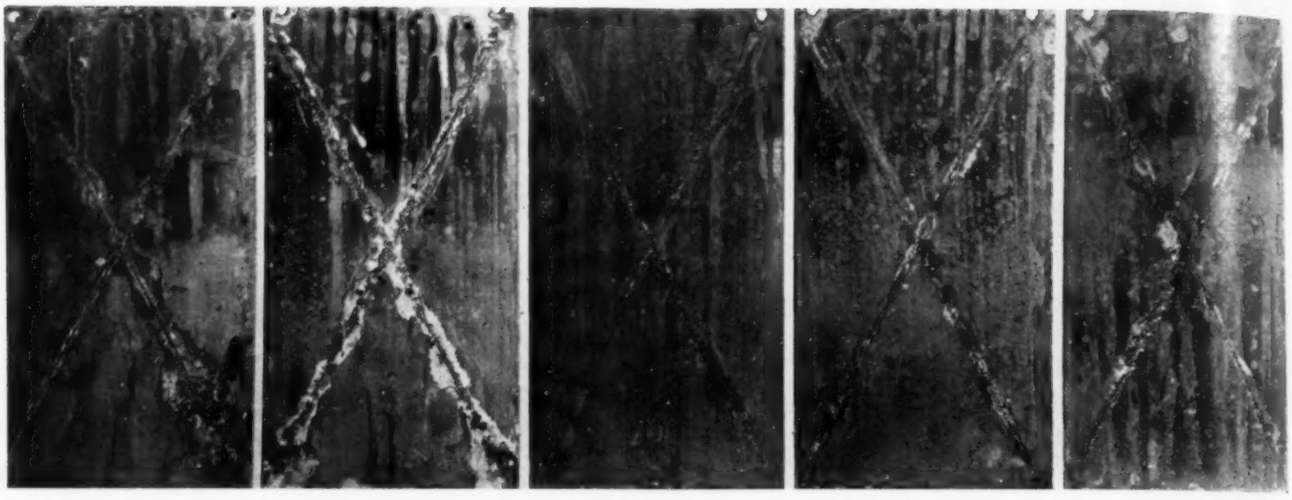
Salt-spray tests of plain-steel panels completed to date include at least two different primers on all the surface treatments listed. In these tests the hot-dip phosphate treatments *Fe-B* and *Fe-H* have been found consistently the best in improving the protective value of paints applied over them. Figure 4 is an example of treatment *Fe-B* (panel *Fe-B-29*) as it appeared after 202 days in the salt spray. It was removed at that time to be photographed and was then returned to the spray. Since there was no change in



Panel Fe-B-29 *Panel Fe-D-29* *Panel Fe-C-29* *Panel Fe-A-29*

Figure 4.—*Comparison of salt-spray tests on steel panels subjected to treatments Fe-B, Fe-D, Fe-C, and Fe-A, prior to painting with two coats of primer 29.*

Panel Fe-B-29: Hot-dip phosphate treatment (Fe-B); salt spray, 202 days' exposure.
Panel Fe-D-29: Phosphate-chromate cold wash (Fe-D); salt spray, 202 days' exposure.
Panel Fe-C-29: Hot-dip chromic acid (Fe-C); salt spray, 110 days' exposure.
Panel Fe-A-29: Hydrochloric acid pickle (Fe-A); salt spray, 48 days' exposure.
(Panels as shown are approximately two-thirds actual size.)



Panel Fe-1-b *Panel Fe-1-y* *Panel Fe-H-1-b* *Panel Fe-H-1-y* *Panel Fe-A-H-1*

Figure 5.—*Salt-spray tests of steel panels showing effect of mill scale on the protective value of paint.*

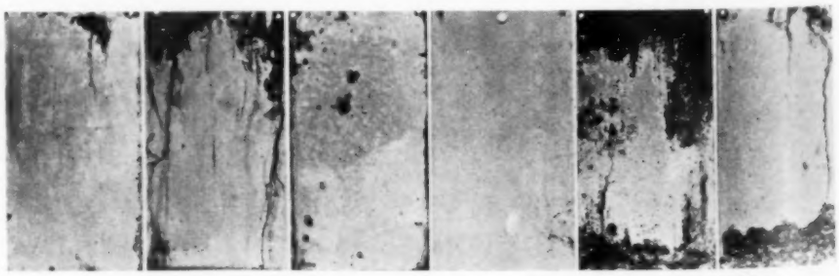
Panel Fe-1-b: Primer 1 over tight mill scale; salt spray, 20 days' exposure.
Panel Fe-1-y: Primer 1 on scale-free surface; salt spray, 20 days' exposure.
Panel Fe-H-1-b: Primer 1 over mill scale after hot-dip phosphate treatment (Fe-H); salt spray, 34 days' exposure.
Panel Fe-H-1-y: Primer 1 on scale-free surface after hot-dip phosphate treatment (Fe-H); salt spray, 34 days' exposure.
Panel Fe-A-H-1: Primer 1 on pickled surface after hot-dip phosphate treatment (Fe-H); salt spray, 34 days' exposure.
(Panels as shown are approximately one-half actual size.)

the appearance of the specimen after the first 40 days of the original exposure, it is probable that the test will continue for a considerable length of time. The phosphate-chromate cold-wash treatments *Fe-D* and *Fe-E* also have given good results in the salt-spray test. Panel *Fe-D-29*, representative of these treatments, appears in figure 4. After the same period of exposure it was almost as good as the panel (*Fe-B-29*) treated by the hot-dip phosphate solution. With other paints, however, this treatment gave slightly inferior results. The hot-dip chromic-acid treatment *Fe-C* showed considerable improvement over the plain pickled surface treatment *Fe-A*, but was decidedly inferior to the treatments mentioned above, as shown by panels *Fe-C-29* and *Fe-A-29* (fig. 4) as they appeared after 110 and 48 days, respectively. The other treatments (*Fe-K*, *Fe-P*, *Fe-M*, and *Fe-S*) listed for plain steel, showed no advantage over treatment *Fe-A* (pickled surface) in improving the protective value of paint applied over them.

In testing the plain-steel panels comparisons were made with the plain pickled surface (treatment *Fe-A*), because on the original hot-rolled annealed sheet material there was considerable variation in the amount and distribution of the surface mill scale. On one side of the sheet the scale appeared to be tight and fairly uniform, whereas on the other side large areas appeared to have no scale at all. Test results to date have been inconclusive in regard to the relative merit of paint applied over mill scale as compared with a pickled surface. However, in short-time tests under severely corrosive conditions, such as the salt spray, it appears that there are no outstanding advantages in either of these conditions, as is shown in figure 5. This figure shows the results of salt-spray tests on selected panels which had tight, uniform mill scale on the side marked *b* and practically no mill scale on the side marked *y*. There appeared to be no particular advantage in painting over mill scale (panel *Fe-1-b*) as compared with a surface practically free of mill scale (panel *Fe-1-y*). Moreover, the hotdip phosphate treatment (*Fe-H*) appeared to be equally effective whether applied directly over mill scale (panel *Fe-H-1-b*), on a surface originally free of mill scale (panel *Fe-H-1-y*), or on a pickled surface (panel *Fe-A-H-1*). Other tests, in which direct comparisons of paints on mill scale or scale-free surfaces are being made, have not been completed, and definite conclusions cannot be drawn.

That the presence of initial surface rust has a much greater effect on paint than the presence of mill scale is illustrated in figure 6. The two right-hand panels of figure 6 were exposed outdoors until covered with rust. Panel *R-Fe-5a* was then painted directly over mill scale and rust. This panel was decidedly inferior in the salt-spray test to panel *Fe-5a*, which was painted over unrusted mill scale, and to panel *Fe-A-5a*, painted on a pickled surface. The other rusted panel, *R-Fe-E-5a*, was given the phosphate-chromate cold-wash treatment *Fe-E* prior to painting. The treatment evidently removed some of the rust and improved the surface for painting. However, the same treatment was much more effective when applied to a surface with unrusted mill scale (panel *Fe-E-5a*).

(To be continued in October issue)



Panel Fe-5a *Panel Fe-A-5a* *Panel Fe-E-5a* *Panel Fe-H-5a* *Panel R-Fe-5a* *Panel R-Fe-E-5a*

Figure 6.—*Salt-spray tests of steel panels showing effect of presence of scale and of rust on the protective value of paint.*

Problems of Metal Specialties Finishing

By Frank V. Faulhaber

Brooklyn, N. Y.

The author stresses the importance of little details when executing high-grade finishes. Controlling dust, using efficient equipment and experienced employees, testing and considering new materials and collecting pertinent information all combine toward achieving superior high-grade workmanship.—Ed.

The management need not wonder and puzzle why the product is not up to expectations, excites not admiration, and wins not commendation from customers known to be discriminating and exacting, when the metal-finishing plant overlooks the importance of little matters. So many times, inattention to small details, in some phases of the work, conduces to inferior workmanship and questionable quality. Adequate consideration to these minor things, by all having in any way to do with the product, will contribute materially to improving the workmanship. These so important details can either lead to or detract from good work. So, wisely proceeds the management when this requirement never is neglected.

This is of paramount concern always as respects the execution of superior, flawless finishes. The problem of producing superb finishes on metal specialties, for example, is typical. Oftentimes pronounced defects show up in the completed work. And yet these very same defects are brought on by lack of attention to some of these details.

The management of one large metal specialties plant takes considerable pride in its products, engaging the better class of workers, using the most modern, up-to-date machinery and equipment, and purchasing only quality materials. Many of this plant's products require superior, long-wearing finishes. Most of the output represents small items, but these require a good lustre and finish. The dust problem, as regards this special type of work, has caused much complaint by reason of spoiled and marred finishes.

Keep Rooms Clean

The matter of dust in the metal-finishing plant assuredly is no small problem. And yet the merest specks of dust on the completed work can cause considerable complaint if not rejected work and lost customers. For an extended period, the metal specialties plant had considerable trouble with some of its finishes. Eventually its perplexities were traced to its own finishing rooms. The management objectified for better quality, paid due heed to the big matters, yet slighted this necessity of cleaning up thoroughly its own finishing rooms. There was too much dust right there, rubbish, dirt and dust being permitted to accumulate overlong. A natural sequence was that, whenever workmen hovered about, as of necessity they must, dust was raised, whether shuffling their feet or not.

A second point of trouble was the open windows, for in this particular locality the atmosphere was unduly dusty, particularly for the requirements of finishing. Dust would come through the windows, lodging on the work and about other parts of the rooms. These may sometimes be viewed as minor, insignificant things. Nevertheless, they cause a metal-finishing plant frequently a long run of worrisome and perplexing finishing troubles.

You sometimes hear complaint among workers, particularly during the warmer seasons, because of the insistence of foremen that windows in the shop be kept tightly shut. This objection can be obviated, in part. The aim should be, so far as possible, to confine the finishing work within a certain set of hours. Employees thus will not be unreasonably inconvenienced. Besides, the output may be facilitated when orders are carefully and methodically scheduled. The products naturally will finish up much better. So many times there will be gratifying improvement in both output and quality by according special attention to just one small trouble. When the management overcomes this small trouble, it will simultaneously hurdle other plant difficulties.

Lustrous work such as this requires care in operation and handling.

Dust Control

There is a host of different dust-controlling equipment, of such an extensive range, in fact, to meet the needs of practically any metal-finishing plant, whatever its size, output and manufacture. Wisely proceeds the management, then, and all those interested in the metal-finishing plant and bent on achieving a superlative brand of products, to accord due consideration to these special dust-controlling devices, installing appropriate machinery and equipment wherever necessary. A world of improvement can be effected right here alone, the execution of the workmanship being enhanced, besides speedening up the work, and lessening appreciably a plant's finishing worries.

Especially the smaller plants without adequate dust-collecting equipment are beset with many troublesome finishing defects. And yet, when each plant operator or employee pitches in, giving proper thought and attention to this matter, it will all weigh materially when striving especially for the better class of high-grade finishes. In one way or another, open doors, for example, induce many drafts, which stir up more dust and dirt. This also affects the drying operation. Then again, when doors are suddenly swung open and closed, there is frequently a whirling of dust, and much of this dust, however fine, settles right on the work. Becomes it not meet, therefore, for the metal-finishing plant management striving for high-grade finished products, to pay due consideration to these important details? The finest of exemplary lacquered finished products are marred, shamefully, when dust particles crop up in the completed work due to inattention to these very details.

Systematic Sweeping

The matter of sweeping the finishing rooms may seem to some as having nothing to do directly with the ultimate work finished. Dispel that delusion! The superintendent of one large factory requires, unfailingly, that set periods be assigned for this particular sweeping task. Maybe there is method in his madness! This plant head feels that it pays to be consistently uniform, even in such a matter as sweeping the floors. He stressed the fact that, by regular and thorough sweeping and cleaning, the employees throughout would be enabled to attend to their duties without interruption and interference. Besides, it was subsequently found, that this plant's employees were more satisfied and more contented when the working surroundings were free of dust, dirt and grime, the presence of which previously dampened the incentive to do good work. Rubbish on the floors, incidentally, can prove a hazard to the operators and a decided drawback to smooth production.

The superintendent of the plant now insists that the sweepers clean up the rooms at the close of the day's work. Thus there is made for a spic and span clean shop ensuring a smooth and clean start for the following day. The superintendent observes that a clean, attractive plant inspires the men to do still better work and more of it. This is well to bear in mind for the management steeped in finishing difficulties and when it strives for an unusually high class of lustrous lacquered finishes.

There perk up a host of more details represented in the matter of the metal plates and other specialties used and handled in one way or another to the final operation. Metal surfaces should be uniformly clean and free of finger marks, spots, cracks, oils, streaks in the metal itself, and of all other defects or foreign substances. Alert supervision proves resultful here.

Small metal specialties being given a clear lacquer spray.

Dust Mars Best Work

Be it known, the smallest flaw sometimes spoils or mars an otherwise superb piece of workmanship, and neglect at this point oftentimes necessitates rejecting the piece. Here again, by due vigilance and attention to this ever-present and worrisome dust problem, the metal specialties plant can accomplish much towards processing a greater volume of work, of superior quality, at the same time eliminating its faulty or questionable work and its incident waste.

How many times, deep in frown, is the foreman of the metal-finishing plant because his finishes show lack of uniformity? Damp, moist weather usually leads to additional finishing room troubles. Yet, by delegating responsibility to one man, who is com-

petent and proficient in this work, the management finds that the plant's troubles have been overcome to a large extent. There is a certain, peculiar experience essential and when a capable, conscientious workman is assigned this work, there will be a resulting improved high-lustered finished product, of more consistent uniformity.

Particularly on rainy days the working conditions are often unsatisfactory by reason of dampness. The problem can be met and mastered by the right sort of air-conditioning, yet many plants are without this efficient form of working equipment. Nevertheless, the watchful executive can do much towards solving this difficulty by seeing to it that on damp and rainy days the work under process is kept extra dry. Less haste should be the rule and more time be allowed to make certain that the finishes are just right under the hampered conditions. When the metal-finishing plant management studies this particular problem, determined on doing something concrete about it, the worries otherwise resident will appreciably diminish.

Spraying Equipment

Considerable alone might be written on the importance of up-to-date, efficient spraying equipment and other apparatus entailed, for the plant's particular needs along this line. Suffice it to say that defective spraying paraphernalia leads to more lacquering and finishing troubles for some finishing foremen than all other problems combined. One faulty detail on the spraying set-up can bring in a wake of inferior, deficient finishes of one kind or another. Firstly, whatever lacquering equipment is used should be of the best, unqualifiedly. Conjunctively, there must be capable, understanding workers, who have their hearts in their work. Your working forces should have real interest and enthusiasm. Can you ever expect top-grade work when these requisites are lacking?

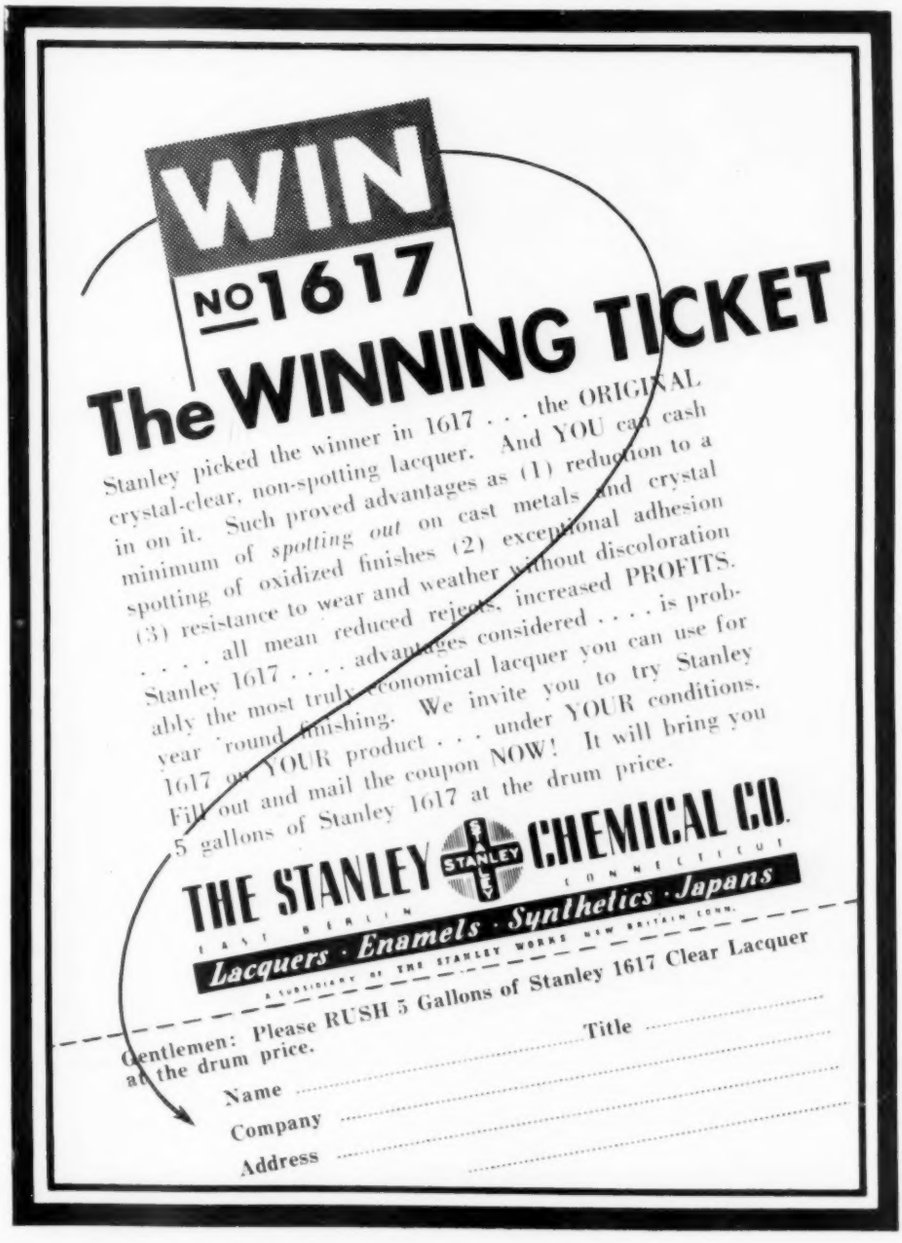
Lax, half-hearted efforts can never make for superlative workmanship. The better type of workman will be the more ready and eager to apply more time, thought and effort towards the objective; he will be the type of employee ever alert to tend to these small, albeit so important details, which, in the final analysis, can either mean exemplary, admirable completed workmanship, or questionable, second-rate, not-so-good output.

Through long experience, the superintendent of the metal-specialties plant found that the dependable, steady, competent finishing operator is an asset worth cultivating and hiring. Experience for the plant assuredly pays here, for it has now succeeded in weeding out floaters who can never be depended upon. More, the experienced operator requires less teaching and breaking in, needs less watching and supervision, fewer commands and less correction. That can mean volumes. The steady, reliable employee, it was learned, usually is the one with more interest and concern for the work; additionally, he has more understanding of its real requirements.

Is Worth More

Admittedly the management is prepared to pay more for this higher type of employee. The superintendent reasons he is worth more. Many times young men, practically novices, assigned to important, exacting finishing tasks, know comparatively little or nothing of what really is wanted in the production line. This lack pops out the more pronouncedly when the plant desires to produce fine, high-grade finishes.

The older, more experienced employees, naturally, can more readily adapt themselves to the plant's policies and requirements, if they have that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ingrained knowledge of high-grade finishing. In this wise the management is free of most of its executive worries. Too, there is saved time, effort, patience and money. Getting the right man, for the right job, would seem to be no small problem, but it solves more than one troublesome finishing difficulty.

The steady, regular worker helps considerably to maintain smooth, even, efficient and dependable production, throughout the year. Consequently, plant orders are routed more satisfactorily, of considerable importance to both management and customers.

The metal specialties plant also found that inexperienced workmen had turned out much faulty or spoiled work. The inexperienced help, especially those that had to be broken in, had caused so much waste of products that, in the course of a year, it had totaled into a staggering item. In a large plant this loss can represent considerable, and yet may never be fully known until someone begins to investigate and compute the volume of waste in comparison with the output. One of the metal specialties plant's objects should be to eliminate waste, so far as possible, a factor otherwise seriously cutting into the plant's overhead and profits.

Testing Materials

Of no small concern, assuredly, is the matter of testing a wide range of finishing materials, the better and more surely to find the most desirable finishing materials for the precise work in hand. The plant should not restrict itself to any one particular brand of finishes, thereby limiting possibilities. Periodically and diligently problems should be discussed with the lacquer manufacturers and their representatives, as also with the makers of other concerned finishing materials.

A wealth of pertinent, useful and constructive technical knowledge is available, regularly, when the metal-finishing plant management rigidly responds. The plant can be in a position to produce much better finishes, of greater variety and attraction, just by more judicious selection of proper finishing products. The more the management and all interested in better metal finishing go into this project, duly and regularly experimenting with more finishes, the more otherwise disconcerting lacquering and finishing problems will be mastered. It is by constant experimenting that the metal-finishing plant constantly improves its products and excels in the field.

The wise and foresighted finishing executives and operatives utilize all opportunity picking up still more relevant and useful knowledge by periodical visits to other plants. Especially is this desirable in the case of plants manufacturing similar kinds of work. No two plants are exactly alike. From each plant can be learned, with profit. Indeed, this is no small detail, yet it is a detail neglected by too many finishing men, whatever their capacity. And it doesn't matter, either, whom one consults for the desired information.

Swapping Knowledge

The executives themselves, of course, have considerable up their sleeves, valuable, pertinent knowledge, which they are eager to share with others, who, themselves, in turn, can contribute their technical ideas, tips, suggestions and pointers, thereby conducing toward mutual benefit.

The technical finishers and minor workers, too, have considerable worthwhile information, that can be used, to advantage, if one will only go about striving for it, all by means of these suggested periodical visits. Many times similar plants to our own are located right in the neighborhood, so conveniently in reach. You will find that other finishers, also, have their particular views and opinions as to what constitutes superior metal finishing, and know just how to go about it. In your own plant it may prevail that the management has done its utmost to produce the best possible finishes, and yet there may be confronting complicated, confusing finishing problems. There is ever a new source, hitherto unknown, to be tapped. Just what are these other plants doing to overcome identical problems? How are they succeeding? What have been the revelations and what the progress? All this is pertinent and can mean much to the management earnestly endeavoring always to better and increase its output.

It is frequently surprising and exceedingly gratifying when the seeker for more knowledge comes upon a new kink, used in some nearby finishing plant, the very kink that can solve the persistently troublesome problem in our own works. Different manufacturers develop different finishing products, all according to their own ideas and preferences. That can mean something of profound importance for the individual delving thoroughly into this problem. Different finished products are achieved by the different range of finishes, which may lead us into a deeper avenue, the further we go into it. To the manufacturer and finisher keen to improve their finished products, and desirous of taking on a wider range, it is of particular importance.

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The Effect of Volatility of Solvent on the Thickness of Paint Layers Prepared by Dipping. E. Ya. Gol'densgtein and B. V. Bak., J. Applied Chem. (U.S.S.R.) 12, 1225-8 (1939). Describes experiments made with paint films to determine thickness under varying solvent conditions. The writer finds that thinner films are produced the higher the boiling point of the solvent, the initial viscosity of the system being the same. For production of paint films of the same thickness, the amount required of high boiling solvents was less than that of low boiling solvents.

Bodying of Dehydrated Castor Oil. J. D. von Mikusch., Ind. and Eng. Chem. Ind. Ed. 8, 1061-9 (1940). Raw, dehydrated castor oil and a varnish made from it were bodied at various temperatures. The increase in viscosity and the change in acid numbers were noted. A cook with Bakelite resin B.R.-2963 was included for comparison. A semi-logarithmic plot of viscosity against time which approached a straight line was used to indicate the rate of bodying at different temperatures. The bodying of dehydrated castor oil proceeded three to four times as fast as the bodying of linseed oil. For instance 3.4 hours were required to attain a 40 poise viscosity of 560°F with raw dehydrated castor oil. The doubling interval for bodying the oil—i.e. the difference in temperature corresponding to the doubling of the bodying rate—was found to be 26.7°F. Corresponding calculations were carried out for linseed oil from available data in the literature.

Determination of Covering Power of Paints by an Electrical Method. P. Prill, Korrosion u. Metallschutz 15, 196-8 (1939). The electric current passing through painted iron panels immersed in normal sulphuric acid was measured and conclusions were drawn as to porosity and suitability of the paint films as protective coatings. To determine the effect of water absorption, the test was also applied to panels which had been previously immersed in distilled water for six days. The method was used to compare red lead and white lead containing paints with those containing carbon saturated with ammonia and the results reported indicate the superiority of the latter over the former with respect to covering power and porosity.

Thermal and Electrical Properties of Synthetic Resin Coatings. S. Shimizu and T. Inai., Electrotech. J. 3, 203-8 (1939). Synthetic resins and materials used for coatings were tested and studied with respect to: (1) Heat endurance, (2) Deterioration of electrical properties due to heat, (3) Variations in hardness and flexibility due to heat, (4) Microscopic deterioration due to heat. The writers claim that polystyrenes have high insulating value at normal temperatures but are defective in heat endurance.

How Should Synthetic Varnishes be Applied? H. Wulf., Farben Ztg. 44, 1136-7 (1939). The important points in applying alkyd resins varnishes are:

(1) Rapid application as a thin film
(2) Proper surface preparation
(3) The use of the right type of thinner depending on the conditions.

Measurement of Gloss, Transparency and Colour. Indian Lac. Res. Inst. Bull. 37, 13 pp (1940). An instrument for measuring gloss, transparency and colour embodying a rectifier type photo cell, is described, the incident beam of light and the reflected beam of light being fixed at right angles.

The Toxic Effect of Trichlorethylene. P. Lande, P. Dervilee and C. Nun., Arch. maladies prof. 2, 454-63 (1939). Trichlorethylene such as is used in degreasers or in commercial solvents produces through breathing, hepatic and renal changes.

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Hammered Finish

Finishes resembling hammered silver, copper, bronze, and other ornamental metals can be applied to products made of any kind of metal and also bakelite molded plastics by the use of a new type of finish, known as "Hammertone", which was recently developed by Maas & Waldstein Company, makers of industrial finishes, Newark, N. J.

In finishing a surface with Hammertone, a base coat of the desired color is first sprayed on. This is followed immediately by a spatter coat of Hammertone liquid, which produces the hammered pattern in the base coat. The product is then baked at medium heat for an hour, which produces a lustrous metallic finish that is very tough and durable. By using a special form of spray gun perfected by Maas and Waldstein, for the spatter coat, even an inexperienced sprayer can produce any desired hammered pattern and maintain it uniformly.

Hammertone, according to the manufacturer, is an excellent finish for metal novelties, heating units, air conditioning equipment, metal cabinets and furniture, bakelite radio cases, and many other products. The speed and ease with which it can be applied adapt Hammertone for continuous production methods.

New Airbrush

Paasche Airbrush Company, 1909 Diversey Parkway, Chicago, Illinois, have announced a new airbrush called "Type CUB." The airbrush is said to have an easy-grip, black tenite handle, an easy-pull trigger and a new fluid lock control.

It is said to have a calibrated control of spray, an easy to clean aircap.

The shorter fluid passage increases coating speed and prevents clogging. Because this new type airbrush is light in weight, it is easy to handle. The shorter, stronger needle with efficient cone-shaped point prevents clogging. There are only two parts to keep tight. This universal type airbrush is said to atomize all finishing materials at highest speed under perfect control and provides a wider, wetter spray. It may be used with pressure tank or overhead bucket, gravity or syphon cup. An outstanding control feature is that this airbrush is adjustable both for any air pressure or any air consumption.

Full information will be supplied without obligation by the manufacturers.

New Airbrush

New Model Explosimeter

Announcement is made by Mine Safety Appliance Co., of a new Model 2 of their "Explosimeter" combustible gas indicator, which incorporates a number of advances in design and construction making for greatest dependability, simplicity and ease of operation.

The Explosimeter Model 2 is stated to be compact, strongly built and light in weight, with a simplified electrical circuit featuring a single filament and single control knob.

True one-hand operation of the instrument is an outstanding Model 2 advantage —one hand is left entirely free to handle sampling line or probe. Immediate response to combustible gas concentrations is provided by the instrument's easy-reading motor, with positive reading on second squeeze of bulb (5 ft. sampling line). The flow system is cast integral with case, without tubing or connections to leak, and a built-in filter chamber is provided to trap dust and moisture. This filter chamber will also accommodate a charcoal cartridge for proper differentiation between illuminating gas and condensable, combustible vapors such as gasoline.

Combustible Gas Indicator

Explosimeter Model 2 is powered by standard flashlight batteries contained in a separate compartment from the working parts. The batteries are entirely isolated from working parts of the Explosimeter—no exposure of working parts when batteries are changed; no possibility of electrolyte from discharged cells affecting electrical controls.

Another interesting feature is the On-Off Signal Bar on the single control knob, which is raised prominently in view when current is turned on, and drops flush with the knob when current is switched off—thus preventing the user from unknowingly leaving the instrument with current on.

While the low-cost replaceable single filament used in Model 2 has a normal useful life of several thousand tests, a spare is contained in the case ready for instant use. Changed as easily as a light bulb.

Full details on this simplified new combustible gas indicator may be obtained on request by writing for Model 2 Explosimeter Bulletin No. DN-4 either to this publication or direct to: Mine Safety Appliances Company, Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

Enamel Stripper

Lea Manufacturing Co., Waterbury, Conn., has announced the development of a new stripper for removing baked enamels.

This material, called "Synstrip 400," is recommended for the stripping of all types of synthetic baked enamels, such as urea formaldehyde, glyptal, resyl, bakelite and other types. It is also recommended for removing air dry enamels, japans and lacquers. The stripper is used diluted with from three to six parts of water and the solutions are operated from 180° to 200° F.

The stripper is stated to be non-corroding to all metals including aluminum, zinc, magnesium and copper alloys.

Manufacturers' Literature

Air Filter. American Air Filter Co., Inc., Louisville, Kentucky describe their "Electromatic" Self Cleaning Air Filter in Bulletin No. 250-C, a 16 page illustrated bulletin. This air filter combines electrical precipita-

POSITION WANTED

Production Finishing Supervisor

Has technical study and experience in finish control, practical material testing, spray motion technique, and time and cost study.

Experienced sprayer of finishing materials—wrinkles, paints, lacquers etc. Age 28. Excellent references. Desires position as Asst. Finishing Foreman or Demonstrator of Materials or Equipment. Will travel.

tion as an integral part of an automatic air filter. Constructional features are described and illustrated and photographs illustrate the efficiency of the air filter in removing dust and smoke.

Fan Wheels. The Advance Aluminum Castings Corp., 2742 West 36th Place, Chicago, Illinois have just issued a new 80 page catalog illustrating their complete line of "Castalu" fan wheels. There are many performance charts and tables showing the capacities of the different sized fans at various speeds and static pressures. Applications of standard makes of flexible couplings are also included.

Constant Temperature Equipment. Precision Scientific Co., 1750 North Springfield Ave., Chicago, Illinois have announced the publication of Bulletin 315 containing 24 pages, illustrated, containing detailed specifications and performance data on a wide range of thermostatically controlled, electrically heated equipment. Comprehensive information is included on cabinets utilizing gravity and mechanical convection heat transfer, in several distinct types, suitable for research, routine testing or processing, in connection with a wide range of materials used in the mechanical and process industries. Applications discussed are accelerated aging of materials, baking of finishes, disintegration tests, and preheating of materials.

Paint Companies Merge

Under a plan recently approved by the stockholders of the *American Asphalt Paint Co.*, of Chicago and its subsidiary, *The Marietta Paint and Color Co.* of Marietta, Ohio, the two companies have been consolidated and are now operating as one corporation known as the *American-Marietta Company*.

Grover M. Hermann, President of the new company, made the announcement this week at the General Offices of the American-Marietta Company, 43 East Ohio Street, Chicago. Mr. Hermann founded the American Asphalt Paint Co. 27 years ago and under his direction the company has become one of the leading manufacturers of heavy-duty industrial maintenance paints under the trade name "Valdura".

The Marietta Paint and Color Co. was founded in 1897, and its President, *George A. LaVallee*, continues as a director of the American-Marietta Company.

The plants operated by the company are located at Kankakee, Illinois; Marietta, Ohio; High Point, North Carolina; and Lincoln, New Jersey.

Industrial Paint Clinic Founded to Solve Paint Problems

The Industrial Paint Clinic, a consultation service for the solution of industrial maintenance paint problems has been founded in Chicago. The Clinic has been established through the enterprise of *Grover M. Hermann*, President of the American-Marietta Company, in recognition of the need for a clearing house of information on significant developments in the paint industry.

More than 100,000 requests for information have come to Mr. Hermann's company during his 27 years in business, many hundreds of them originating in the metal processing industry.

In the past these problems, covering every conceivable circumstance in which paint is used, have been turned over to an already harassed scientific staff. Now such problems can be handled in the Clinic with the conservation of much time and effort, for in the new laboratories it is possible to simulate nearly all known conditions of weather, climate, and industrial wear and tear.

An elaborate manual, the Maintenance Painting Handbook, has been prepared by the Clinic and will be distributed gratis to industrialists and paint buyers.

Requests for the Handbook and information on maintenance painting problems may be addressed to the Industrial Paint Clinic, 43 East Ohio Street, Chicago, Illinois.

METAL FINISHING BUYERS' DIRECTORY

Metal Industry Publishing Co. Inc., 116 John Street, New York City, publishers of Metal Finishing, and Plating & Finishing Guide Book, have announced the future publication of a 1940 Buyers' Directory. The directory will list suppliers and manufacturers of all equipment, supplies, processes and chemicals used in the plating and finishing industry. A special section will be devoted to organic finishing.

Advertisers in the directory or in any of Metal Industry Publishing Company's publications will be entitled to bold faced listings in the directory.

EGYPTIAN FINISHING LACQUERS

For use over colored enamels

Withstand Buffing

Can be used directly on polished metals

Tough and flexible

Impervious to atmospheric conditions

Resistant to handling, buffing, tarnishing and marring

EGYPTIAN FINISHING LACQUERS are extremely durable and may be either air-dried or baked.

Ask for further information

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● In addition to Clear Lacquers made to meet standard and individual requirements, we also make a complete line of pigmented lacquer enamels and Synthetics, air-dry and bake.

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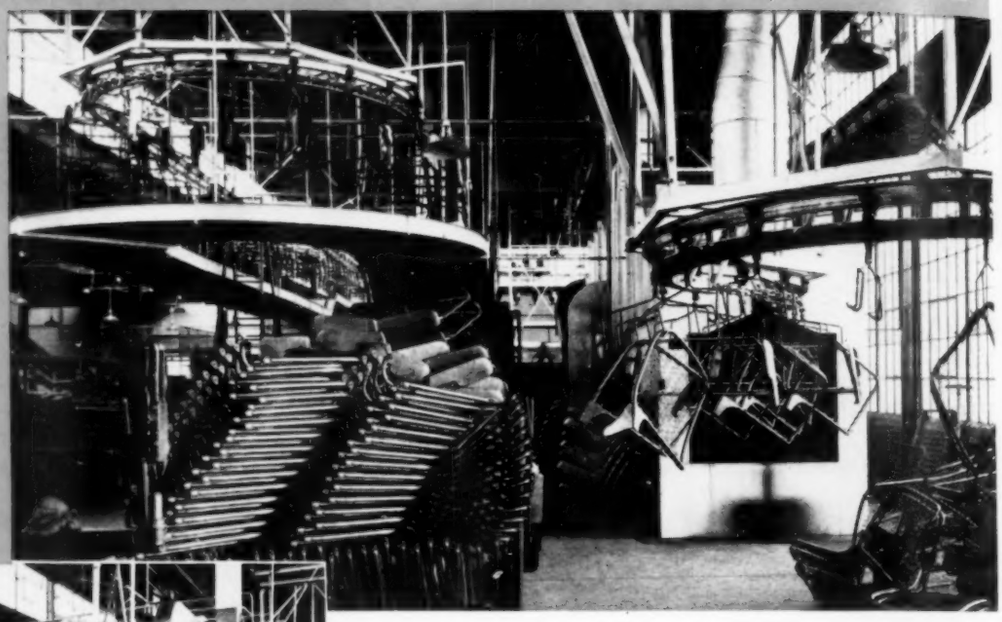
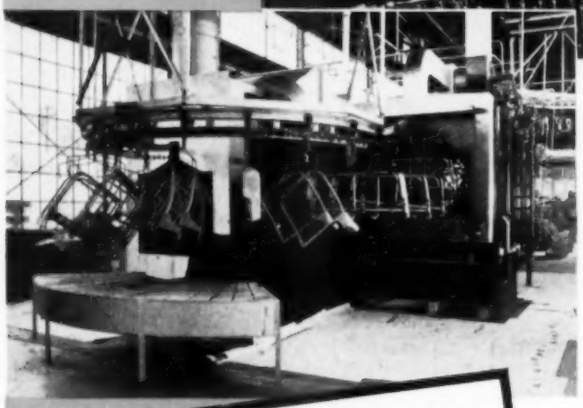


At right: General view of the complete Mahon Finishing System, installed at the American Metal Products Company's plant, Detroit, Mich.

Below: Products emerging from the Mahon Flowcoat Painting Machine and entering the Enamel Baking Oven—parts of the Complete Mahon Finishing System installed at the American Metal Products Plant, Detroit, Mich.



. . . designed to do YOUR job *Efficiently and Economically*

The complete Mahon Finishing System installed at the American Metal Products plant in Detroit is a typical example of Mahon's thorough planning and advanced engineering in this highly specialized field . . . it includes Metal Cleaning, Drying, Painting and Air Drying Equipment coordinated into one system which is conveyorized and entirely automatic. A Mahon Flowcoat Painting Machine applies the finish in this particular installation. Today, when it's a question of Finishing Equipment, manufacturers turn their entire problem over to Mahon engineers with complete confidence—Why? . . . because they know that Mahon engineers, backed by seventeen years of research, development and practical experience in every industry where finishing is an important production operation, are better qualified to plan the type of installation best suited to their particular requirements. You can greatly improve the finish on your product, and reduce your costs too, with a thoroughly engineered, properly coordinated Mahon System. Call in a Mahon engineer today—consultation and study of your requirements will not place you under any obligation.

THE R. C. MAHON COMPANY
DETROIT - - CHICAGO

Designers and Manufacturers of Complete Finishing Systems, Metal Cleaning Machines, Rust Proofing Machines, Hydro-Filter Spray Booths, Ovens of All Types, Filtered Air Supply Units, Hydro-Foam Dust Collectors and many other Units of Special Production Equipment.

OVENS

Illustrated here is a box type Oven installed by Mahon for the Press Sign Co., St. Louis, Mo. The R. C. Mahon Company design and build Ovens of all Types to meet any temperature requirement. Embodied in the construction of these Ovens are many very desirable features from a standpoint of utility and long life. Details will be furnished on request. Write today.

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PALMER H. LANGDON
1868-1935

METAL FINISHING

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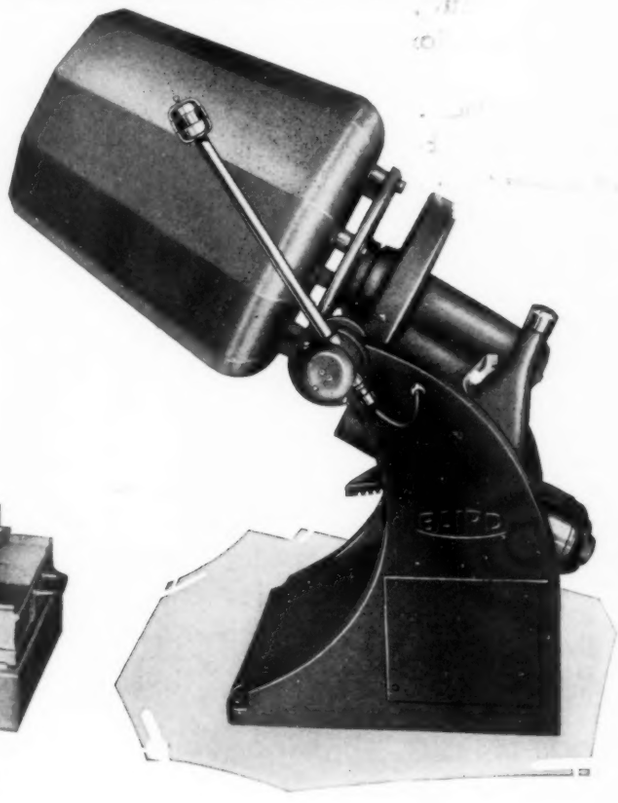
HORIZONTAL BARRELS **TILTING BALL BURNISHING**



This shows a High and Narrow Type of Barrel mounted on "Baird" Model B. or Pedestal Type Motor driven Oblique Tilting Tumbler.

As shown the barrel was lined for use for burnishing with hardened steel balls.

These barrels may be of any suitable material depending on the job. Cast iron or fabricated steel unlined or lined with rubber etc. for rolling in abrasives.

Made in 20" dia. x 6" for No. 1 Tumbler
Made in 24" dia. x 8" for No. 2 Tumbler

This shows the side of a No. 1 BAIRD Model B. Single Oblique Tilting Tumbler with a No. 22 Sheet Steel Polygonal Barrel and with an Automatic Electrical Tilting Device.

This device AFFORDS GREATEST SAFETY—LEAST LABOR—LEAST FLOOR SPACE—LEAST AMOUNT OF DISTANCE TO MOVE WORK in USING the tumbling barrels. SAVES TIME AND FLOOR SPACE.

When tumbling questions come up "ASK BAIRD ABOUT IT"

THE BAIRD MACHINE COMPANY

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Since 1846 specializing in high production machinery for articles of wire and for ribbon metal. Also machines to turn, bore, etc., castings, forgings, etc., up to 10½" diameter.

METAL FINISHING
PREPARATION, ELECTROPLATING, COATING
OCTOBER, 1940

Voltmeters without the attendant use of ammeters are being used to control plating solutions. In some cases control of the solution may work out in other cases, particularly where plating to specifications is done, voltage control may result in trouble. The total voltage drop in the plating circuit is dependent upon the resistance of the bus-bars, the points of contact between bus-bars and anodes, the polarization at both anode and cathode, and the resistance of the solution. When plating solutions have low polarization, and low current densities are used, voltage control of the plating process tends to be more nearly accurate than when higher current densities are used. With higher current densities, the polarization at the electrodes is greater and the resistance of the conducting circuit is apt to increase due to heating.

In addition, the conductivity of plating solutions may vary considerably, especially cyanide solutions. The shape of the cathode may also have a bearing on the resistance drop from the cathode to the anode, from purely geometrical considerations.

The use of both ammeter and voltmeter is to be recommended, the ammeter being used to control the rate of current and the voltmeter to indicate the condition of the electrical circuit and of the solution.

An increase in voltage for the same current density may denote a drop in solution composition, or faulty electrical contacts which may occur especially between the anode hooks and the bus-bars. The correlated use of ammeter and voltmeter is especially significant in high current density barrel plating. High voltage would tend to indicate increased resistance in solution, insufficient anode area, poor electrical contacts, etc., which result in excessive heating of the solution, resulting in increased spray and possible decomposition of the plating solution.

Stain-Free Work Requires Good Rinsing

The discussion of staining of cadmium plate made in the September issue of Metal Finishing should be amplified. One of the most important operations is rinsing and the statement made in the September issue regarding the discoloration of nitric acid dipped cadmium is only valid when incomplete rinsing is done.

The necessity for clean water is not fully understood and in some plants cadmium plated work is rinsed in the same rinse water where work plated in other solutions is rinsed. This is especially true when copper or nickel plated work is rinsed in the same water as cadmium plated work.

It is unfortunate that more attention is not given to clean water in the plating room especially in the final rinsing. Too often there is not a sufficient flow of water to maintain a clean final hot water rinse. It is understood that cold water cannot be constantly run into the hot rinse tank due to the increased cost of heating.

In tanks where water is heated by coils and there is no direct overflow, the condition of the water may become such that any deposit of metal which is subject to discoloration, will be affected. At times exhaust steam is used to heat water, in which case, boiler treating compounds or rust from the pipes will contaminate the solution.

The necessity for carefully rinsing the work which has been dipped into a chromic acid solution is well understood. It must be rinsed in water kept separately so that all other solutions in the plating room will not become contaminated.

It would be well if the same precautions are taken for all rinse waters as then there would be the assurance of having a film of clean water on the work, which will not be the cause of discoloration regardless of the nature of the previous cleaning or brightening of the surface.

National Metal Congress and Exposition To Be Held at Cleveland, Ohio

World's Largest Industrial Exhibit and Technical Sessions Will Be Held for Five Days Beginning October 21. Extensive Programs Will Be Held By American Society for Metals, American Welding Society, Wire Association and A.I.M.E.

The National Metal Congress and Exposition, combining the metal world's largest industrial exhibit and sessions for principal technological societies dealing with metals, will meet in Cleveland, Ohio for five days beginning October 21st.

The 1940 Congress and Exposition will be the largest in the twenty-two year history of the event, according to Wm. H. Eisenman, Managing Director. More than 100,000 square feet of exhibit space have been taken by exhibitors representing every branch of the metals and associated industries. Extensive technical programs of the American Society for Metals, The American Welding Society, The Wire Association and the Iron and Steel division and the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers will be held in conjunction with the show. Technical sessions are generally scheduled to be held in three Cleveland hotels as well as at the larger meeting rooms in the Municipal Auditorium.

The theme of the 1940 National Metal Congress and Exposition is "New Aids to Production"—an especially appropriate keynote by virtue of the gigantic defense program now under way. Every item and method to be seen will have direct relation to the preparedness program.

The welding industry will be represented at the metal show by all types of welding: arc, spot and resistance; by gas welding and oxy-acetylene gas and gas cutting equipment. Included in this group are electrodes and electric controllers as well as various grades of welding wire for gas and electric welding.

Heat treating furnaces of all types will be on display: salt bath, annealing-electric, gas and oil fired; induction, atmospheric controlled furnaces of all types and sizes. In addition there will be furnaces and heating equipment for heating rivets and bars; industrial oil heating apparatus and various insulating materials for furnaces and electric heating elements.

In steels visitors will see tool steel, stainless steel, construction steel, valve steel for aircraft and automotive units, heat and corrosion resistant alloys, sheet, strip and high-speed and other steels. These will be shown in finished form and through products made from them.

In the non-ferrous field there will be aluminum, aluminum alloys, magnesium, magnesium aluminum alloys, copper, brass, bronzes, zinc, die casting shapes and forms, non-ferrous wire and other alloys cast and wrought. Machinery for die casting, wire drawing and spring forming will be shown.

The gas industry will be represented by gas fired, heat treating furnaces and many gas heating industrial appliances.

Testing equipment to indicate hardness, tensile, torsional strength, fatigue and many other properties of metals will be demonstrated.

Temperature recording and control equipment will include devices for indicating, recording and controlling temperatures.

Tools of all types will be on exhibit. They include hack saws and files, electric drills, diamond tools, tungsten carbide cutters, diamond test cutters and reamers. Included in this group are abrasive cutting machines and abrasive wheels.

Plating processes and materials to be shown at the NMCE include cleaners, degreasers, generators, plating barrels, polishing lathes and supplies, new plating solutions. Methods in castings will be illustrated, dealing with malleable heat treated and heat corrosion resistant items.

Hundreds of other aids to better production will be shown. They include heat treating salts, carburizing salts, compounds and supplies. Noble metals will be shown in new uses. Handling equipment such as cranes, trucks and hoists are included. Pieces of various optical measuring, metallographic and spectrographic equipment, blue printing machinery and drafting room equipment are to be exhibited. Laboratory equipment to be shown includes polishing machines, chemical determinators and other items for chemistry laboratory work.

Ferro-alloys for production purposes will include nickel, molybdenum, vanadium, chromium, manganese and many other metals in this field.

Fastener items to be shown include nuts, bolts, screws, rivets and lock washers. Hard surfacing alloys for various parts of industrial machinery will be on display.

Petroleum products, quenching oils, rust preventatives and metal cleaning compounds will be shown. Sand blast equipment and detergents will be included.

Industrial appliances to be shown will include safety shoes, masks, goggles and other safety equipment as well as water dispensing equipment.

X-ray equipment, turbo compressors and metal cloth are included

in the miscellaneous classifications.

Trade and business publications in the metals and associated fields have made arrangements to provide various informational services at their exhibit booths.

Trade and professional associations, allied with the metals field, will be represented by exhibit booths.

Technical programs arranged by the four societies are larger this year than ever before.

The American Society for Metals' technical program will present 67 papers in fourteen sessions and will include a symposium on "Surface Treating of Metals"; an afternoon lecture course on "Strength of Materials Under Combined Stresses" and an evening course on "Quenching of Metals".

The Edward de Mille Campbell Memorial Lecture will be delivered on Wednesday morning, October 23rd, following the annual meeting of ASM. This year's Campbell Memorial Lecture will be prepared and delivered by *Dr. Samuel L. Hoyt* of Battelle Memorial Institute.

The educational lectures on the ASM program include daily talks to be delivered by *Dr. Maxwell Gensamer* of Carnegie Institute of Technology. Evening lectures in the educational series will be delivered by *A. A. Bates*, Westinghouse Electric & Manufacturing Company; *W. J. Conley*, University of Rochester and *R. G. Roshong*, Lindberg Steel Treating Company.

The ASM banquet will be held on Thursday evening, October 24th, at Hotel Statler. Headquarters for ASM will also be at this hotel with morning technical sessions held in the same building and afternoon and evening discussions and lectures taking place in the spacious Public Auditorium.

The annual fall meeting of the two metals divisions of A.I.M.E., held during the first three days of the Congress, will feature joint and simultaneous sessions, committee meetings and a roundtable discussion on "Electrolytic Polishing". Headquarters of the society will be at Hotel Cleveland and the annual banquet held Tuesday evening, October 22nd.

Fifty-three papers are tentatively scheduled for presentation by the American Welding Society in its general sessions and in its industrial and fundamental research groups. The annual banquet of AWS will be held at the society's headquarters—Hotel Cleveland—on Thursday evening, October 24th (no speaker at A.W.S.).

The Wire Association will present many interesting new motion pictures, in addition to a select list of technical papers and discussions. Headquarters for this society have been announced for Hotel Carter and its banquet scheduled for Wednesday evening, October 23rd.

This year's National Metal Congress and Exposition will be the largest in history—20% larger than the 1939 Exposition in Chicago. It will cover the upper and lower levels of the Cleveland Auditorium's underground Exposition Hall and Annex as well as the North Hall and the Main Exhibition Hall.

Hotel reservations are being made direct with hotels and through *Mark Egan*, Executive Vice President, The Cleveland Convention and Visitors Bureau, chairman of the Housing Committee.

The largest attendance in history is anticipated at the National Metal Congress and Exposition for 1940.

The following companies, in the plating and finishing industries, will exhibit and have attendants at the Metal Show.

Alox Corp., Niagara, Falls, N. Y.
Aluminum Co. of America, Pittsburgh, Pa.
Alvey Ferguson Co., Cincinnati, Ohio.
American Brass Co., Waterbury, Conn.
American Cyanamid & Chemical Corp., New York, N. Y.
American Foundry Equipment Co., Mishawaka, Ind.
American Machine & Metals, (Tolhurst Div.) E. Moline, Ill.
Baker & Co., Inc., Newark, N. J.
Bausch & Lomb Optical Co., Rochester, N. Y.
G. S. Blakeslee & Co., Chicago, Ill.
Bridgeport Brass Co., Bridgeport, Conn.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Cambridge Wire Cloth Co., Inc., Cambridge, Md.
Carborundum Co., Niagara Falls, N. Y. (Abrasive Div.)
Chase Brass & Copper Co., Waterbury, Conn.
Cowles Detergent Co., Cleveland, Ohio.
Crown Rheostat & Supply Co., Chicago, Ill.
Despatch Oven Co., Minneapolis, Minn.
Detroit Rex Products Co., Detroit, Mich.
Dow Chemical Co., Midland, Mich.
E. I. duPont de Nemours & Co., Wilmington, Dela. (Electroplating Div. and R. & H. Chemicals Dept.)
Electric Furnace Co., Salem, Ohio.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
General Electric X-Ray Corp., Chicago, Ill.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Hobart Bros. Co., Troy, Ohio.
Independent Pneumatic Tool Co., Chicago, Ill.
International Nickel Co., New York, N. Y.
Leeds & Northrup Co., Philadelphia, Pa.
Chas. F. L'Hommedieu & Sons, Chicago, Ill.
Macklin Co., Jackson, Mich.
P. R. Mallory & Co., Inc., Indianapolis, Ind.
Manhattan Rubber Mfg. Co., Passaic, N. J.
Matchless Metal Polish Co., Glen Ridge, N. J., and Chicago, Ill.
Mine Safety Appliances Co., Pittsburgh, Pa.
New Jersey Zinc Sales Co., New York, N. Y.
Norton Co., Worcester, Mass.
Oakite Products, Inc., New York, N. Y.
Osborn Mfg. Co., Cleveland, Ohio
Packer Machine Co., Meriden, Conn.
Pangborn Corp., Hagerstown, Md.
Park Chemical Co., Detroit, Mich.
Phillips Mfg. Co., Chicago, Ill.
Pyrometer Instrument Co., New York, N. Y.
N. Ransohoff Inc., Cincinnati, Ohio
Revere Copper & Brass Co., Rome, N. Y.
Ruemelin Mfg. Co., Milwaukee, Wisc.
Standard Steel Spring Co., Coraopolis, Pa.
Sterling Grinding Wheel Co., Tiffin, Ohio.
C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.

The Reaction of Zinc and Iron In Hot-Dip Galvanizing

PART II

By Dr. Ing. Heinz Bablik

This is part two of Dr. Bablik's excellent paper on hot galvanizing. In this installment the effects of dipping temperature on the character of the galvanized coating are described and illustrated. The effects of the curvature of the base metal are also illustrated. —Ed.

The series of microsections in Fig. 6 show the influence of dipping temperature. The dipping time was one hour in all cases. The dipping temperature involves in another way the influence of heat, in that the equilibrium conditions are again influenced. As in the results of experiments with the dipping time, it is in the main the "pal" layer that increases with increasing temperature. In comparison with the "pal" layer, "an" and "ab" seem to be practically unchanged if the irregularities are ignored. But examination of Fig. 6 reveals a new development at a dipping temperature of 490° C. The "ab" layer—it is thought to consist of the ζ phase—seems almost to have disappeared. Only a very small layer of "ab" is found. A surprising development occurs at a temperature of 495° C. as can be further observed from Fig. 6. We see that by this temperature there only exists a very thin "an" layer, the main part of the iron-zinc alloy layers consists of the "pal" layer—which is thought to be δ_1 phase—and in this matrix we find correctly formed crystals of the ζ phase. In our opinion a secondary crystallization has taken place. There is a reaction ($\eta + \delta_1 \rightleftarrows \zeta$) and in this way these crystals are formed perfectly. If we now raise the temperature a little higher, to 500° C. as shown by Fig. 6, this is no longer the case. The crystals have absolutely disappeared. In our opinion, up to the present, it is a sign that at this temperature the ζ phase no longer exists, and that therefore in this respect the diagram is verified. But possibly another explanation can be found. The fact that is to be remarked is that in the range where this secondary crystallization takes place a very heavy attack of the iron occurs. At this critical temperature, the solubility of iron in molten zinc is exceptionally high. From Fig. 6 it can be learned that in the range of dipping temperatures from 500° C. to 515° C., the "pal" layer seems to have quite disappeared, and only an "an" layer seems to be present.

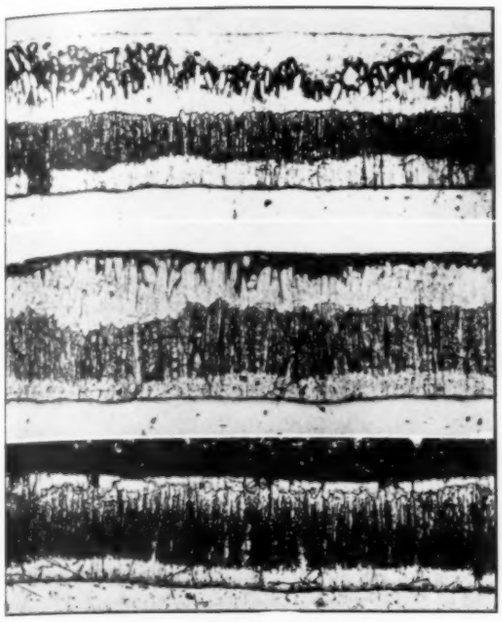
Of course there are still other factors which may control the sequence of events when solid iron is dipped into molten zinc. Our knowledge is not yet complete, but we may show what is to be taken into consideration. There are not only all the factors controlling the velocity of diffusion (such as perhaps the addition of some elements, which may be present in the iron or in the molten zinc), but also all the factors that control the form of boundaries of the phases, which may be of direct or indirect influence.

Thus, it is seen from Fig. 7 how the structure of the alloy layer is altered by the fact of the surface of the iron being concave or convex. As already mentioned, these differences in the surface disappear with increasing dissolution of the iron surface, and so one can more easily observe these factors in a short dipping time. It is noticeable that on the concave side no "ab" layer exists and particularly that under such conditions the "ab" layer is not strongly coherent.

It is quite the contrary on the opposite convex side. Here the "ab" layer has its normal structure. An explanation of this is seen from Fig. 8 which shows the coating at a point where a scratch was deliberately made. The direction of the "pal" layer that has always the tendency to grow vertically to the iron base will be observed. As the iron base again has a concave form the different crystals of the "pal" layer grow together and the result is that no coherent "ab" layer can be formed. We see the different ζ crystals move away from the "pal" layer. This influence of a marked corner can again be seen in Fig. 9. Where such a corner exists, there is as at every other point quite a definite "an" layer. But on the corner itself there is no "pal" layer: that is to say, the crystals that form the "ab" layer under ordinary conditions are immediately formed.

The microsection of a galvanized screw demonstrates very clearly the difference in the alloy layer structure due to concavity or convexity of the iron ground. A higher magnification (Fig. 10) of the top of one thread of the screw shows that in the main it is the "an" layer that disappears and that the "pal" layer is diminished to a considerable extent.

It still remains to be considered what may happen if there is an addition of some other metals to the zinc bath. In general only aluminum and tin are in use to any extent. As far as aluminum is concerned, it seems that it has some influence on the equilibrium conditions and also a direct influence on the velocities of diffusion and the crystal structure.



475° C.

485° C.

490° C.

Fig. 6. (Three pictures left). Effects of dipping temperature on the structure of galvanized coatings. Dipping time: 1 hour. Bath: electrolytic zinc. 120X.

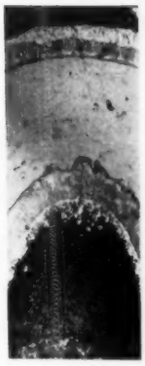


Fig. 7. Structure of the alloy layers on both sides of a folded sheet.

495° C.

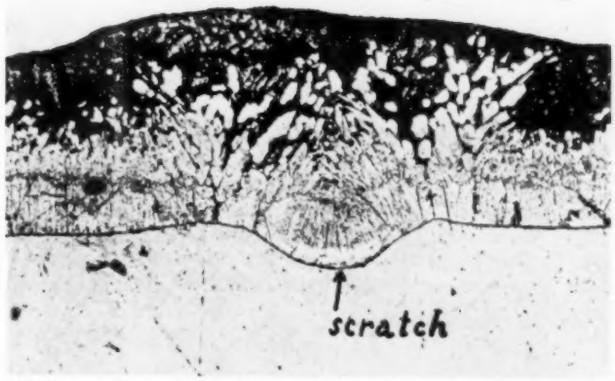
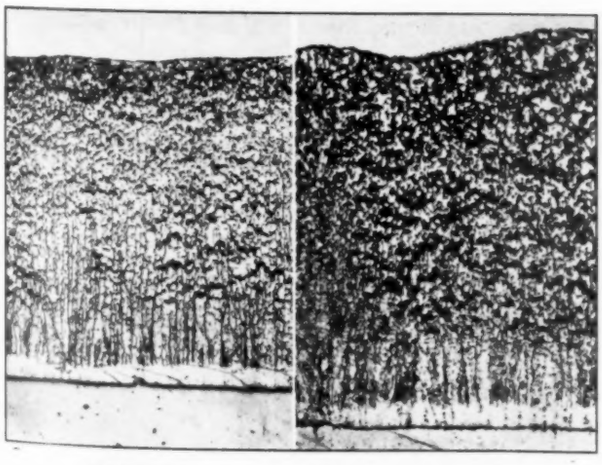


Fig. 8. Influence of a concave iron surface on the structure of a galvanized coating.



500° C. 515° C.

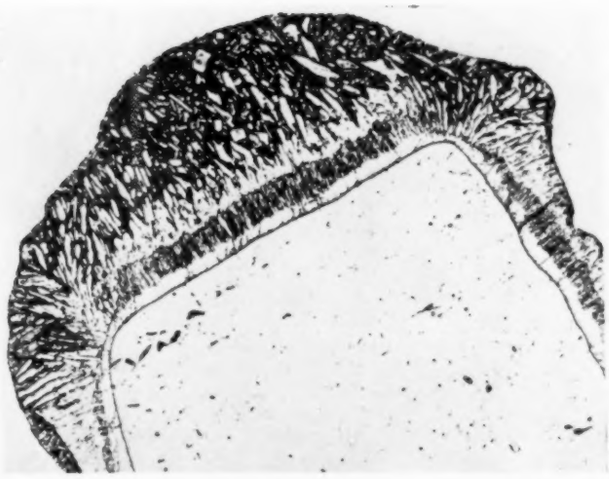


Fig. 9. Structure of the alloy layers on a corner. Dipping time: 1 hour. Dipping temperature: 460° C. 70X.

Five-Foot Reflectors *made by* Electroforming*

Development, emphasizing rapid progress of modern forming methods, also points to new possibilities for use of rhodium plating when applied to base of electroplated nickel.

The copper back of this reflector has been provided with a protective mask which leaves only the bright nickel reflecting face exposed to the final plating step—a flash of rhodium 30 millionths of an inch thick. This rhodium plating tank at Bart Laboratories is the largest of its kind in the world.

THE progress of electroforming methods, which have been applied to the making of wire cloth and other metal products, now is given further emphasis by their use for the construction of searchlight reflectors 62 inches in diameter.

The development holds an additional point of significant interest in that it demonstrates some new possibilities in the commercial use of rhodium plating when applied to a base of electrically deposited nickel.

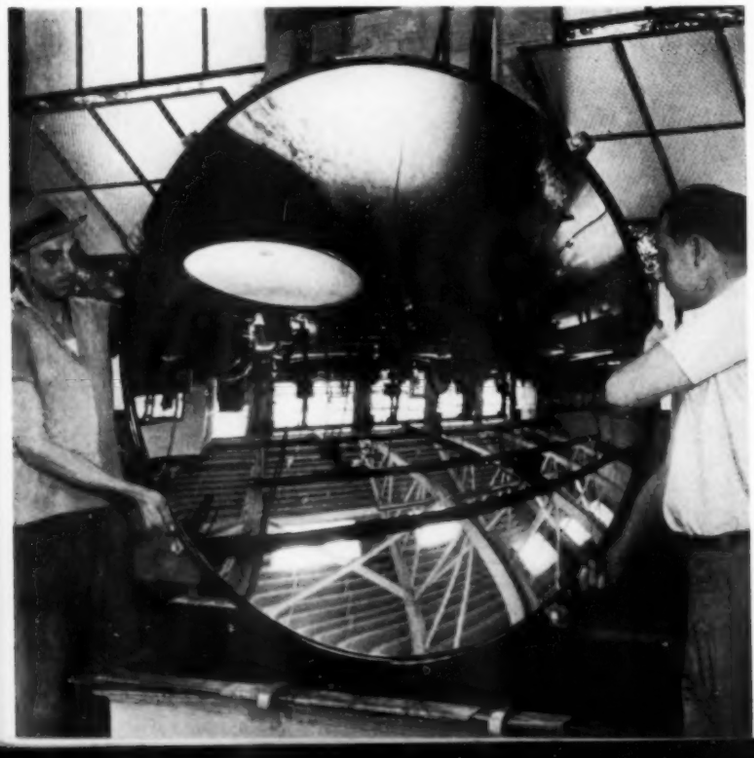
The reflectors are electroformed on a nickel-surfaced electroformed metal mold, or "starting sheet," held in a metal frame which is coated on the back by a non-conducting lacquer, or mask, to prevent the building-up of metallic deposits. The nickel surface is passivated to aid in final separation. A coat of nickel 3-5 thousandths of an inch thick is then applied to the outer, or convex, passivated nickel face of the mold. This is followed by a slightly heavier coating of copper, to which a preformed bronze ring is applied, and the whole assembly goes in the tank for the heavy deposit of copper.

Following the plating on of the copper, the heavy layers of nickel and copper, firmly bonded to each other, are stripped from the mold in the form of a bi-metal reflector, the copper on the convex face and the nickel on the inner, or concave, polished face. When split from the nickel mold surface, this inner face has the polish of the original mold and needs only a coloring to brighten the nickel surface before rhodium plating.

The electroformed reflector of copper and nickel is given a protective mask on the copper side to prevent the introduction of copper into the rhodium bath and to confine the deposition of rhodium to the reflecting face alone. It is then mounted in a non-conducting frame of Bakelite. Thus insulated, except for its nickel surface, the reflector is immersed in the plating bath. At the plant of Bart Laboratories, Belleville, N. J., where the reflectors are made, the rhodium is applied in the largest tank of its kind in the world. It has a capacity of over 400 gallons.

For this specific purpose, and for reflectors of all sizes, whether electroformed or fabricated by older means, the

(*Continued on page 536*)



Upon this mold, or "starting sheet," the searchlight reflectors are formed by electroforming successive layers of nickel and copper at the Belleville, N. J., plant of Bart Laboratories. Stripped from the mold, the bi-metal bases, thus formed, are placed in the rhodium bath for application of rhodium surface to the inner, or nickel face.

*Reprinted from Inco, Vol. 17, No. 2, published by International Nickel Co., N. Y.

The Electrodeposition of Lead from Lead Acetate Solutions*

By Frank C. Mathers[1]
and
Joe B. Schwartzkopf[2]

Prof. Frank C. Mathers

Combinations of glue and cresol as addition agents were found to produce solid, thick, finely crystalline cathode deposits from lead acetate solutions containing sodium acetate and free acetic acid. The effect of the concentration of all the components has been outlined. A current density of 1.2 amp./dm.^{2} (11 amp./ft.^{2}) may be used. Thin deposits of lead, 0.001 and 0.003" on steel were sufficiently adherent for soldering.

Introduction

The early idea of Anson G. Betts[3] and his contemporaries that the basis of a lead depositing electrolyte should be a strongly dissociating acid has since been disproved. It has been found that almost any soluble lead salt will produce a solid, dense electrolytic deposit if the proper organic addition agents are used. However, no weak acid bath has been generally accepted for plating or refining purposes since: (1) a low current density must be used; (2) large amounts of addition agents, which tend to make the deposits brittle, are required; and (3) the high cell voltages cause increased power cost.

In the following table lead acetate ($PbAc_2$) and acetic acid (HAc) baths, which are claimed to produce good adherent deposits of lead, are briefly described:

Author	Bath Composition	Add. Agent	C.D. in amp./dm.^{2}	Deposit
Glaser[4]	100 c.c. H_2O 55 g. $PbAc_2$ 14 g. KAc HAc	None	0.4	solid, adherent
Mathers[5]	6 to 10% $PbAc_2$ 4% NH_4ClO_4 HAc	0.25% peptone	0.4	solid, thick
Tucker and Thomssen[6]	20 g. $PbAc_2$ per 100 c.c.	1 to 5 g. licorice extract	0.5	good adherent
Mathers[7]	100 c.c. H_2O 10 g. $PbAc_2$ 4 g. NH_4ClO_4 2.5 to 5 c.c. HAc	gum from aloes extraction	0.4	good, smooth, slightly crystalline
Mathers[8]	13 oz. $PbAc_2$ 6 oz. NH_4ClO_4 7 oz. HAc/gal.	extract yellow popular sawdust	0.4	brittle
Izgaruishev and Ivanov[9]	100 c.c. H_2O 25 g. $PbAc_2$ 2.5 g. HAc	0.1 g. carpenter's glue 0.2 c.c. pyridine	5.0	white, finely crystalline
Taft and Barham[10]	liquid ammonia solution of $PbAc_2$			non-striated, clearly crystalline
Izgaruishev, Orlova, Lainer, and Stepanov[11]	100 c.c. H_2O 2.5 g. $PbAc_2$ 2.6 g. HAc	0.1 g. gelatine 0.2 c.c. pyridine 0.05 g. o-toluidine	0.13	homogeneous, fine-grained on iron
Yakulov and Borozdin[12]	$PbAc_2$ HAc NH_4OH	Protective colloid		

*Presented at the 28th Annual Convention of the American Electroplaters' Society, June, 1940.

Experimental

Throughout the experimental work 150 ml. beakers containing 100 ml. of the electrolyte were used as electrolyzing vessels. The lead anodes, 5x2.5 cm., were cast in a graphite mold. Amalgamation of the anodes with 1 to 3 percent of mercury reduced the production of loose slime in the baths. Small copper wires were sealed into the anodes when cast to make electrical connection. The cathodes, 2.7 x 3.7 cm. (area on one side equal to 10 sq. cm.) were cut from strips of thinly rolled lead and were cleaned in dilute nitric acid, followed by several washings in both hot and cold distilled water. They were suspended in the baths by means of small copper wires. The electrodes were 4 cm. apart. Continuous gentle agitation was maintained in the baths by stirring rods revolving at the rate of 120 revolutions per minute. Dynamo circuit furnished the current. All experiments were carried out at room temperature.

After studying both the single and combined effects of some fifty addition agents, it was found that combinations of glue and cresol in baths containing lead acetate, sodium acetate, and acetic acid produced the best deposits. Both the glue and cresol must be used together in the same bath, for neither one of them by itself will produce a satisfactory deposit. However, high concentrations of cresol, 20 drops per 100 ml. of solution, will produce rather crystalline deposits which are practically devoid of trees.

Armour's No. 2 bone glue was used exclusively. Aqueous solutions of glue, prepared fresh daily, were added to the baths. Crude cresol was purified from the non-hydroxy part by dissolving 200 drops of the crude cresol in 3.2 g. of 95 percent sodium hydroxide, diluting to 100 ml., and filtering. A determination showed that each drop of cresol weighed 0.041 g. On addition of the caustic solution of the cresol (1 ml. continued 2 drops of cresol) to the baths, the cresol present dissolved sufficiently for use.

Technical lead acetate and glacial acetic acid were used throughout the experimental work. Other salts employed were C.P. All baths were filtered before use unless otherwise indicated. pH values were determined potentiometrically with a quinhydrone electrode.

For the purpose of simplifying the tables and descriptions, a series of numbers for evaluating the qualities of the various deposits were used. The quality of the deposits decreased as the number increased, and the description for each number is as follows: (1) Smooth, light grey, finely crystalline surface, rounded edges and corners; (2) Smooth, light grey, finely crystalline surface, rounded edges, projecting corners; (3) Smooth, light grey, finely crystalline surface, projecting edges and corners; (4) Solid projections on surface, edges, and corners; (5) Crystalline projections on surface, edges, and corners; (6) Projecting trees, feathered, dark, and of no value whatever.

Deposits for both 3 hours and 20 hours, 0.005" and 0.032" thick respectively at a current density of 1.2 amp./dm.^{2}, were recorded.

Table I

Effect of Variations in Concentration of Cresol with Glue Constant.

All the baths contained 10 g. $PbAc_2.3H_2O$, 16 g. $NaAc.3H_2O$, 5 g. HAc, and 0.1 g. glue in 100 ml. of solution. C. D. 0.4 amp./dm.^{2} Voltages varied from 0.3 to 0.45.

No.	Drops of Cresol	Classification of Deposits 3 Hrs.	20 Hrs.
1.	1	1 slightly striated	3 slightly striated
2.	2	1 completely striated	2 completely striated
3.	5	6 dark	6
4.	10	6 very dark	6

All baths were slightly turbid, and the turbidity was greater with the increases in cresol. Even though insufficient glue was indicated, it was well shown that the concentration of the cresol must be controlled. Two to three drops seemed sufficient.

Striations appeared to decrease as the glue concentration was increased, and 0.5 g. to 0.6 g. of glue seemed sufficient. As the concentration of the glue was increased, the deposits became more brittle.

Table II

Effect of Variations in Concentration of Glue with Cresol Constant

All the baths contained 10 g. $PbAc_2.3H_2O$, 16 g. $NaAc.3H_2O$, 5 g. HAc, and 2 drops of cresol in 100 ml. of solution. C. D. 0.4 amp./dm.^{2} Voltages were 0.3.

No.	Grams of Glue	Classification of Deposits 3 Hrs.	20 Hrs.
1.	0.2	1 slightly striated	2½ completely striated
2.	0.4	1 less striated	1½ slightly striated
3.	0.6	1	1
4.	1.0	1	1

Table III

Effect of Variations in Concentration of Cresol with Increased Glue and Increased Current Density.

All the baths contained 10 g. $PbAc_2.3H_2O$, 16 g. $NaAc.3H_2O$, 5 g. HAc, and 0.6 g. of glue in 100 ml. of solution. C. D. 1.2 amp./dm.^{2} Voltages varied from 0.3 to 1.0.

No.	Drops of Cresol	Classification of Deposits 3 Hrs.	20 Hrs.
1.	0	3	5
2.	2	1	3
3.	5	1½ dark	2½ slightly beaded
4*.	5	1½ dark	2½ slightly beaded
5.	10	1½ dark beaded	2½ dark beaded
6*.	10	1½ dark beaded	2½ dark beaded

* Baths not filtered.

With increased glue and increased current density, it appeared that slightly higher concentrations of cresol might be used. Five drops of cresol produced a good deposit, but it was dark and slightly beaded. After several hours the deposit became lighter in color, no

doubt due to the decreased concentration of the cresol. Apparently the best quantity of cresol was 3 to 4 drops. Filtering of the baths seemed to have no effect on the deposits. Both turbidity and cell voltages increased proportionally with increased cresol. Increasing the concentration of the glue to 0.8 g. produced no better deposits.

Table IV

Effect of Variations in Concentrations of Acetic Acid.

All the baths contained 10 g. $PbAc_2.3H_2O$, 16 g. NaAc. $3H_2O$, 0.6 g. of glue, and 3 drops of cresol in 100 ml. of solution. C. D. 1.2 amp./dm.^{2} Voltages varied from 0.5 to 0.7.

No.	Grams of HAc	pH	Classification of Deposits 3 Hrs.	20 Hrs.
	0	7.5	3	5
2*	0	7.0	1½	4½
3	0	6.9	1	2½
4	½	6.2	1	1
5	1	5.9	1	1
6	3	5.4	1	1
7	5	5.1	1	2 striated
8	10	4.9	1½	3 striated beaded
9	20	4.5	3	6
10	40	4.3	3½	6

† Bath contained basic lead acetate, 5 $PbAc_2.2PbO$ instead of $PbAC_2$.

* Crude cresol used and solution heated, because the caustic solution of cresol should be used only in acid baths.

Quite a little insoluble matter was present in the baths which contained no free acetic acid. After filtering, solutions 1, 2, and 3 were the least turbid. No doubt a part of the cresol was filtered out, thus partly accounting for the poorer deposits for the twenty hour period. The turbidity was a minimum with one-half gram of acetic acid and increased regularly as the acid concentration was increased. This series showed that baths containing from one-half to three grams of acetic acid produced the best deposits and that the optimum quantity of acid was probably two grams.

Table V

Effect of Variations in Concentration of Sodium Acetate.

All the baths contained 10 g. $PbAc_2.3H_2O$, 2 g. HAc, 0.6 g. of glue, and 3 drops of cresol in 100 ml. of solution. C. D. 1.2 amp./dm.^{2}

No.	G. $NaAc.3H_2O$	Voltage	pH	Classification of Deposits 3 Hrs.	20 Hrs.
1	0	2.8	4.7	3	6
2	8	0.9	5.2	1½	2½
3	16	0.6	5.4	1	1
4	32	0.5	5.7	1	1

This table showed definitely the importance of using rather large quantities of sodium acetate. Although thirty-two grams of sodium acetate produced a slightly better deposit, sixteen grams are recommended for the sake of economy. Eight grams were clearly insufficient.

The deposits were apparently equally good from baths containing ten and fifteen grams of lead acetate but were distinctly less good from baths containing only five grams of lead acetate. Unfiltered baths apparently produced just as good a deposit as filtered baths. This table showed that 2 amp./dm.^{2} was too great a current density.

Table VI

Effect of Variations in Concentration of Lead Acetate.

All the baths contained 16 g. $NaAc.3H_2O$, 2 g. HAc, 0.6 g. of glue, and 3 drops of cresol in 100 ml. of solution. Voltage varies from 0.5 to 0.7.

No.	G. $PbAc_2.3H_2O$	Classification of Deposits 1.2 amp./dm.^{2} 3 Hrs.	20 Hrs.	2.0 amp./dm.^{2} 3 Hrs.
1	5	1½ dark beaded	2½ beaded	6
2*	5	1½ dark beaded	2½ beaded	6
3	10	1	1	3
4*	10	1	1	3
5	15	1	1	2
6*	15	1	1	2

Discussion

Turbidity. All of the baths described in the above tables were somewhat turbid. As previously mentioned, both increased acidity and increased concentrations of cresol increased the turbidity. The order of adding the addition agents had no effect on the turbidity nor the resulting lead deposit. Variations of the quantity of glue within the range for good deposits did not affect the degree of turbidity. Crude cresol, five to seven drops, can be added directly to the baths if sufficiently agitated and just as good lead deposits obtained as by the use of the sodium hydroxide solution of cresol. Turbidity was somewhat reduced, but due to the insoluble oily matter which adhered to the electrolyzing vessels and to the cathodes, this method of adding cresol is not recommended.

Use of Salts Other than Sodium Acetate. Equivalent quantities of sodium chlorate and sodium perchlorate produced slightly better deposits than did sodium acetate. Sodium perchlorate was best, and the only reason that it is not recommended is that it is more expensive than sodium acetate. The deposits obtained were not enough better to warrant the additional cost. Baths containing sodium nitrate produced good deposits for a time, but the deposits gradually became dark and spongy.

Thick Deposits of Lead. A 500 ml. bath, electrolyzed for 427 hours at a current density of 0.4 amp./dm.^{2}, produced a solid, thick, finely crystalline deposit of 273 grams of lead. Glue and cresol were added periodically.

Current Efficiencies and Throwing Power. The cur-

Table VII

Grams of Cu in Coulometer	Amperes per Sq. Dm.	Cathode Grams Pb Deposited	Cathode Yield Percent	Anode Grams Pb Dissolved	Anode Ampere Efficiency Percent
Bath No. 1					
0.1115	0.8	.3618	99.53	.3703	101.8
.1518	1.2	.4935	99.73	.5009	101.2
Bath No. 2					
0.1115	0.8	.3620	99.58	.3728	102.5
.1518	1.2	.4929	99.61		

rent efficiencies of two baths were determined. Bath No. 1 contained 10 g. $PbAc_2.3H_2O$, 16 g. $NaAc.3H_2O$, 2 g. HAc, 0.6 g. of glue, and 3 drops of cresol. Bath No. 2 differed in that it contained 5 g. HAc.

The throwing power of a bath containing 10 g. $PbAc_2.3H_2O$, 16 g. $NaAc.3H_2O$, 2 g. HAc, 0.5 g. glue, and 3 drops of cresol per 100 ml. solution was measured by the method of Haring and Blum[13] and found to be 6.6 percent. The distance ratio of the near and far cathode was 1 : 4. The total current density used was 1.0 amp./dm.^{2} According to the Heatley formula[14], the throwing power was 8.8 percent.

Deposition of Lead on Iron. Sheet iron was plated with lead 0.001" and 0.003" in thickness. Smooth, finely crystalline deposits were obtained. The brittleness of the deposits increased with increased concentration of glue in the bath. The adherence of the lead varied. In some instances it was unusually good and was sufficiently adherent for soldering. In general, the thicker the deposit the less good the adherence. A copper strike did not seem to improve the adherence of the lead.

Summary

1. Combinations of glue and cresol as addition agents were found to produce smooth, thick, finely crystalline deposits of lead from lead acetate solutions.
2. The presence of sodium acetate or some similar salt was necessary to obtain good deposits.
3. A low concentration of free acetic acid produced the best deposits.
4. The following bath composition is recommended: 10 g. $PbAc_2.3H_2O$, 12 g. to 16 g. $NaAc.3H_2O$, 2 g. HAc, 0.4 g. to 0.6 g. of glue, and 3 to 4 drops of cresol (in a sodium hydroxide solution) per 100 ml. of solution. Five to seven drops of crude cresol may be used.
5. Too much cresol tends to produce dark deposits.
6. The baths were somewhat turbid. Filtering seemed to have little effect on decreasing the turbidity.
7. A current density of 1.2 amp./dm.^{2} (11 amp./ft.^{2}) may be used.
8. Agitation of the baths during electrolysis was desirable.
9. Lead deposited on iron was sufficiently adherent for soldering.
10. The advantages of lead acetate baths for lead plating are: (a) The baths can be produced conveniently from commercially available materials; (b) the components of the bath are comparatively cheap; and (c) the bath does not attack ceramic vessels.
11. The disadvantages of acetate baths are: (a) the low conductivity increases the power cost; (b) the deposits are somewhat brittle due to the large quantities of addition agents required; and (c) the adherence of thick deposits on iron is often not good.

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Applying Metal to Glass

The time-honored method of applying metals, such as platinum to glass, is to apply the platinum compound by hand, and then fire the glassware, thus reducing the platinum.

It has been recently reported that ductile zirconium and titanium can be used for scratching glass to produce a brilliant metallic streak of the metals on the glass. This streak is silvery in appearance and can be buffed to a high brilliance. Since these metals are not tarnished in the air and are not attacked by alkaline solutions, they will withstand the mechanical abrasion to which glassware is subjected, particularly cleaning, and in addition the streaks can be coated with other metals by electroplating. The use of these metals is particularly valuable when firing is to be avoided. One gram of titanium is said to be sufficient to apply a coating 5,500 sq. centimeters or about 6 sq. ft. per gram or 2,700 sq. ft. per pound. Zirconium will cover about 20% less area.

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Five-Foot Reflectors Made by Electroforming

(*Concluded from page* 532)

use of rhodium plate has been found to hold many advantages when used on a nickel base. It has a high hardness—about 600 Brinell—is tightly adherent to its underlying layer, has a high degree of reflectivity, and resistance to tarnish. The exceptionally thin coatings of rhodium, which can be used safely, of course, is another factor of importance since a small amount can be used to cover a wide area. While a thickness of about 20-30 millionths of an inch is used for the reflectors over nickel 5 thousandths of an inch thick, in other uses deposits as thin as 1 millionths and 2 millionths have been found highly satisfactory when plated over nickel from 3 ten thousandths of an inch thick upward.

Full protection is lacking with underlayers of copper and its alloys, whose relation to rhodium in electrochemical action is such that disfigurement by corrosion may result. Nickel, on the other hand, is passive when plated with rhodium and thus provides adequate protection. As in the case of chromium and other plated metal surfaces, nickel forms a tightly adherent bond with rhodium.

Blue Gelatine-Copper

By Wilder D. Bancroft and T. R. Briggs

This very interesting article is reprinted from Volume 22, Transactions of the American Electrochemical Society, (now The Electrochemical Society). The paper was presented by Prof. Wilder D. Bancroft at the 22nd General Meeting, held early in September 1912. Little mention has been made in the literature of this process for producing blue colors, and the article is herewith reproduced to present the development to a new generation of electroplaters.

The electrolytic production of a form of colloidal copper was performed with certain copper solutions containing gelatine.

This new form of copper develops a remarkable series of colors when immersed in certain copper solutions, a peacock blue being the finest color obtained.

The process of development is an adsorption of hydrous copper oxide by the surface of the colloid film.

Methods of coloring metal objects gold, golden brown or red have been described.—Ed.

COPPER and the copper alloys such as brass and the bronzes lend themselves very readily to artistic decoration by means of colored superficial films or "patinas". Great as is the variety of colors which may thus be imparted to copper, nevertheless a rich and true blue patina for this metal is practically unknown. It was while seeking such a blue surface film that the electrolysis of copper acetate solutions containing gelatine was first performed by us. One gram of gelatine was dissolved in 325 cc of a 1 per cent solution of cupric acetate and this mixture electrolyzed between carefully cleaned and burnished electrodes of sheet-copper. The electrolysis was continued for five minutes at a cathode (and anode) current density which varied between 0.15 and 0.45 amp./sq. dm. (1.3 to 4.1 amps./ft.^{2}). The process was carried out at room temperature

The electrolysis performed, the cathode was found to be covered on its inner surface with a thin, pale brown deposit, which, when rubbed with the fingers, was seen to possess a peculiar, slippery surface caused by a very appreciable amount of gelatine deposited simultaneously with the metallic copper. No gas became visible at either pole during the passage of the current.

In itself, this pale brown cathode deposit gave no indication of its peculiar properties, and it was by chance only that these were discovered. An electrode freshly coated with layer of the gelatine copper was by an oversight allowed to remain in the solution of copper acetate from which the film of metal had just been deposited and the current was turned off. On removing the electrode from the solution, it was noticed that the brown color originally possessed by the cathode film had given place to a purplish blue of extraordinary brilliance and beauty. This led to further experiments.

A second electrode was then coated with a film of gelatine copper and after careful rinsing with cold tap water, immersed in a 5 per cent solution of copper acetate containing no gelatine. Straightway there ensued a remarkable series of color changes upon the surface of the copper deposit; hues of startling evenness and intensity followed each other in regular succession until the electrodes had acquired a magnificent deep-blue coloration. This process we shall speak of as a "development", since it bears a certain resemblance to the development of the silver image in the process of photography.

Experimental

Effect of Gelatine. After the process of development had been discovered, more systematic study of the formation and nature of gelatine copper was undertaken. It then became evident that gelatine must be present in the electrolyte and that this colloid exerted a tremendous influence upon the nature of the cathode deposit. The term "gelatine-copper" was thus justified. The optimum gelatine concentration was found to lie between 0.25 and 0.66 per cent. The electrolysis of copper acetate solutions containing no gelatine failed to give the developable films, nor was it possible to substitute other hydrophilic colloids such as starch or gum arabic for gelatine or glue.

Nature of the Electrolyte. Electrolysis of copper formate, acetate and propionate solutions containing gelatine, resulted in cathode films which developed blue in copper acetate, although this development was imperfect in the case of the deposits from the formate solution. Copper sulphate solutions of different strengths and varying gelatine content failed absolutely to give developable deposits. Similar results were obtained with solutions of copper nitrate and chloride.

Effect of Temperature. Variation of the temperature at which the electrolysis was performed, led to interesting results. Between 20° and 40° C. the cathode deposit was of the usual pale-brown color and gave a more or less satisfactory color development to blue in copper acetate. At 50° C. or at higher temperatures, the cathode deposit was colored a bright red to a brick red and was unaffected by the developing solution. Between 55° and 60° a short electrolysis with a low current density gave a gold colored but very thin film which had a rather irridescent appearance. These gold and red films can be lacquered with complete success and are interesting in their application to metallochromy.

Other Factors. The best results were obtained with copper acetate or propionate solutions made up in the proportion of 1 or 2 parts by weight of the crystallized salt to 100 parts of water. The electrolyte should be neutral or at most very slightly acid. The current density must be low—between 0.15 and 0.45 amp./sq. dm. and the process need not exceed 5 minutes in duration. The nature of the metal used as cathode is of little importance as long as the copper solution is not decomposed by it. Thus with nickel, brass and platinum, good deposits were obtained as adherent cathode films which developed a good blue color.

The Development of the Blue Color. A 5 per cent copper acetate solution containing no gelatine was used as the developing bath throughout this work, although a copper propionate solution may also be employed. Copper formate developer gave less satisfactory results. A large number of other salt solutions were then tried as developers with practically no success. Thus in normal copper sulphate solution, a film of gelatine copper was colored a dull, dark indigo. In N/50 copper sulphate (1.6 g/L) a fairly good blue color was developed, although the colors obtained with sulphate solutions are distinctly inferior to those prepared with acetate developer. Very dilute copper nitrate oxidized the film to dark brown copper oxide, while a chloride solution spoiled the deposit entirely.

Several oxidizing solutions were next used with negative results. Potassium chromate, bichromate, permanganate, perchlorate, chlorate and persulphate failed to give even a trace of blue coloration. The films were usually oxidized slowly to brown cupric oxide. Reducing solutions gave no development. The film of gelatine copper was unaffected by dilute, warm, hydrazine hydrate and underwent accelerated blue development in copper acetate after such treatment.

A solution of sodium acetate gave no blue coloration of the copper film, nor was it otherwise with the acetate solutions of other metals. Hence this phenomenon must be a function of the copper contained in the developing solutions.

Reverse Development. An electrode covered with a deep blue film was immersed in a very dilute aqueous solution of hydrazine hydrate, and in a short time bubbles of nitrogen began to form on the blue surface. The blue color then slowly faded away until, passing in reverse direction through the series of colors previously described, the film of gelatine copper again took on its original brown color. This process was called a "reverse development."

The reverse development completed, the electrode was rinsed in distilled water and once more immersed in the usual copper acetate developer. The blue color formed again quickly, but was a bit thin and uneven.

If a film of gelatine copper is allowed to stand undeveloped for several hours, it completely loses its power of developing in copper acetate. This is probably due to its oxidation by the air, because it was found that treatment of such a "dead" film with hydrazine hydrate was sufficient to regenerate its powers of development. The same result was obtained with a film after immersion in warm dilute hydrogen peroxide. No development occurred until the layer of oxide so produced had been reduced with hydrazine.

Theory and Conclusions

Schuetzenberger, by the electrolysis of copper acetate solutions, obtained at the cathode a peculiar form of copper, and, being unable to explain its unusual behavior, he announced it as an allotropic modification. Wiedemann incorrectly contended that the new form of copper was really the oxide of that metal, while Benedicks has advanced the idea that we have to deal with a solid solution of acetic acid in copper. It can be shown, however, by a careful study of their results and by consideration of the facts of colloid chemistry, that the allotropic copper of Schuetzenberger is merely the normal metal in the form of an irreversible colloid gel.

The same conclusion is applicable to the deposits of gelatine copper described in this paper. The gelatine acts here as the "protecting colloid", migrates by cataphoresis to the cathode, and there inhibits the growth or crystallization of the copper nuclei. Gelatine copper is an irreversible gel of colloidal copper. The whole phenomenon is but another example of the marked influence of organic and other colloidal substances upon metals prepared by electrolysis, accounts of which have appeared in the papers of Mueller and Bahntje, Snowden and others.

What is the nature and mechanism of the process of the color development? This is indeed a difficult problem, chiefly because of the exceeding small quantities of reacting material necessarily dealt with. The blue, although a superficial color, is nevertheless not the color of a thin film of gelatine or oxide bringing about interference disturbances in the reflected rays of light. Nor does it seem to be the color of a definite chemical compound. The blue layer does contain oxide as is shown by its action in hydrazine and yet it cannot be prepared by any process of simple oxidation. It cannot be produced by the partial coagulation of the copper gel.

It was shown by Wiedemann, that Schuetzenberger's copper possesses the power of adsorbing very considerable quantities of copper oxide from copper acetate solutions. This observation furnished the clue to the process of development. The color changes that appear upon the film are the result of a surface adsorption of hydrous copper oxide from the copper solution. The hydrous copper oxide is present as a suspension in very appreciable quantities in the acetate or propionate solutions, being the product of hydrolytic dissociation. This being the case, we should expect the best development with the acetate solutions and but little color effect with the sulphate and chloride developers.

The reversal of development caused by hydrazine is due to the reduction of the adsorbed oxide. There seems to be a certain definite concentration of oxide in the copper film necessary for the production of a blue color. As the concentration of the oxide increases by continued adsorption, the film passes through the series of colors so distinctive of the development.

In conclusion it can be said in support of this hypothesis that it is in accord with many of the established facts of colloid chemistry and explains in the best possible manner this decidedly obscure phenomenon. Stannic oxide adsorbs gold from the suspension and forms the "Purple of Cassius"; under very special conditions colloidal copper adsorbs hydrous copper oxide and similarly gives an intensely colored adsorption compound.

Biography of Frank Rushton

By Fred A. Herr

Frank C. Rushton, vice-president of Los Angeles Chapter, A.E.S., has been connected with the electroplating industry in various capacities almost since the day he landed in the United States as a youthful immigrant from England in 1901.

With but two interludes, he has been associated with American electroplating for nearly 40 years, and is still active as Southern California district representative for Lasalco, Inc., of St. Louis. The two interruptions in his career occurred in 1904, when he was forced to take a leave to recover health undermined through his work as a polisher in St. Louis; and again in 1917, when he donned the olive drab of Uncle Sam's overseas forces.

He has had opportunity for observing the growth of the industry from two aspects: from inside the shop, where for some 13 years he served in nearly every capacity from scrubbing boy at 25 cents an hour to foreman; and from the outside, where as sales executive for more than 20 years for such firms as A. P. Munning Co. and Lasalco, Inc., he was in position to observe the scientific development of the industry in many parts of the United States as well as in Mexico.

Early Worker in Pottery

Mr. Rushton was born in Worcester, Eng., May 29, 1882, the son of Walter and Emma Rushton. His father was employed in the Worcester Royal Porcelain Works. It was in this plant, his public school education completed, that Frank Rushton went to work as a figure maker at the age of 14.

"I stayed on that job nearly five years," said Mr. Rushton, leaning back on the couch in his home at 2209 Reservoir Street, Los Angeles. The couch was strewn with papers and documents—army discharges, citations, old letters, pictures of long ago—to which he referred now and then to jog his memory on some nearly forgotten date or incident.

"Yes, I stayed on that job till 1901," he reiterated reflectively after a moment of contemplation over an old letter. "I was 19 years old when I quit."

Nineteen — and the urge that assails many young men of that age was upon him. He wanted to travel and see things, find some new fields which would take him out of the prosaic factory job which threatened to cast him into a rut before even he had reached voting age. To young men of that period America was synonimous with action and adventure and opportunity. Big things were taking place across the sea. Jobs, always plentiful in America, were said to be even easier to get just then.

Arrives in America

So young Frank went to America. He went alone and landed at New York late in the spring of 1901. From New York he traveled to St. Louis, Mo., for *William Hale*, an uncle, was superintendent of the Charter Oak Stove and Range Co. in that city, and Frank hoped to get a job there.

There wasn't much difficulty about getting the job. The uncle attended to that. But chance would have it that he put Frank to work in the nickel plating department of the firm's Cass Avenue plant. In that manner, and with no design on his part, Mr. Rushton entered the electroplating field. He's been in it ever since, with the exception of the two interludes previously mentioned.

Frank C. Rushton
Taken recently at his home in Los Angeles, Cal.

Mr. Rushton chuckled in response to a question by the interviewer.

"What did they have me doing?" he observed. "Nothing very important, you may be sure, for the pay was 25 cents an hour."

Specifically, the work to which he was assigned was scrubbing the background of nickel after it had been buffed. The work was chiefly on cast iron stove parts. Electrocleaning prior to plating, Mr. Rushton explained, was practically unknown then, and all units had to be scrubbed by hand, using powdered pumice on the brush.

"We used rouge, no white finish," he said musingly, trying to recall details of shop practice of that long-ago day. "There were no electric cleaners and our scrubbing was done with an ordinary scrub brush. I had six months of that and then they put me to polishing."

The life of a polisher and buffer and the environment in which he had to work differed considerably at the turn of the century from conditions prevailing today, according to Mr. Rushton. The Charter Oak shop worked ten hours a day. The Union scale was 25 cents an hour. There was no exhaust fan in the shop, no blowers to carry away emery dust and buffing lint. The shop was lighted by gas, supplemented by candles in the winter. Yet, it ranged among the "better" plants in the middlewest of that day. The foreman, incidentally, was *William Lamoureux*, a brother of *Ernest Lamoureux*, Ernest and Frank today are members of Los Angeles Chapter.

Polishing, of course, was regarded as one of the most hazardous jobs in the shop in those days, Mr. Rushton declared. He had available no accurate figures, but said that to the best of his recollection insurance premiums on polishers and buffers were based on a life expectancy of less than ten years.

Loses Health

He worked in the ——— ——— polishing department for three years. Then the inevitable caught up with him. By the spring of 1904 his health had been affected to such an extent that he was compelled to quit work.

"I *had* to quit," said Mr. Rushton. "The dust and lint I had swallowed for three years had hurt my lungs. Fresh air was what I needed most, according to the doctors. I had a little money saved up, so I started out to travel around the country . . . . Doing what? . . . . Doing nothing," he replied dryly. "Doctors' orders."

The treatment was effective. Plenty of fresh air and a paucity of physical exertion was the combination that restored his health. That he went broke in the interim, not once but several times, was a mere incident, annoying, perhaps, but not disastrous.

A reminiscent chuckle escaped him as he recalled those days.

"I certainly went busted," he observed. "But what's that to a kid of 22? I knew I was getting my health back, and nothing else really mattered."

By 1907 he felt ready to get back into harness. He applied for a job in the plating department of a Jackson, Mich., factory, and was put to work at his old job of polishing. The environment, however, was not to his liking. Many of the employees were ex-convicts who had learned their trade polishing shovels in the state penitentiary at Jackson. Mr. Rushton endured it a month, then returned to St. Louis and to his former job in the polishing department of Charter Oak Stove and Range Co.

"Only three years had elapsed since I'd been out of touch with things," said Mr. Rushton, "but conditions had changed considerably, both in the St. Louis shop and in the electroplating industry itself. They were changes for the better. The Union scale in the St. Louis shop for competent polishers now was $5 to $6 a day. Working conditions were better, for the company had installed a blower and exhaust system as well as electric lights."

Few of his former associates were still at Charter Oak when Mr. Rushton returned in 1907. Bill Lamoureux, the foreman, was gone, and polishers, like printers, were migratory individuals, not tarrying long in any one place. After a year as a polisher, Mr. Rushton (only 26 years old in 1908) was made foreman of the plating, polishing and buffing department. He served in that capacity until the day he entered the army in 1917.

During this period he first made the acquaintance of an enterprising young former plater who had transferred to the selling ranks, a step Mr. Ruston was eventually to take himself. This man was *Ernest "Ernie" Lamoureux*, who at that time was sales representative for Zucker-Levett and Loeb Co., and later for Munning-Loeb Co., and its successors, A. P. Munning Co. and Hanson-Van Winkle-Munning Co.

Reviewing the ten years of his second tenure with the Charter Oak Stove and Range Co., Mr. Rushton recalled no outstanding technical development or production technique in electroplating other than general growth of the industry. Electrocleaning was introduced during that period (1907-17), he declared, but did not come into general use in the industry until after he had joined the army in 1917. During the greater part of his foremanship at Charter Oak the old hand scrubbing method was used.

Goes "Overthere"

The second interlude in Mr. Rushton's career began in August, 1917. He resigned from the Charter Oak Company on August 13 and a few days later emerged in the role of Private F. C. Rushton, Company B, 138th Missouri Infantry Regiment. The training period at Fort Sill and other camps endured until May, 1918, and at its conclusion Buck Private Rushton had become Sergeant Rushton. He recalled being summoned to the company commander's quarters one day and being informed that an official of the Bureau of Standards in Washington had requested he be transferred to duty in the Bureau. The invitation was declined, Mr. Rushton said, for he wanted very much to get to France and take a crack at the Germans. It was not until the national convention of the A.E.S. at Philadelphia in 1919 that he learned that Dr. William Blum had been the man who had asked for his transfer to the Bureau.

In May, 1918, his outfit went overseas as part of the 35th Division. Sergeant Rushton was promoted to first sergeant on June 22, just prior to his first trip to the front. He saw front-line action in the Alsace-Lorraine Sector from June 28 to July 19 and again from August 12 to August 31, and in the Meuse-Argonne drive which began September 26, 1918. On the first day of the Meuse-Argonne battle, he was hit by a machine gun bullet and put out of action for the duration of the war. Hospitalization followed at Nantes, France, until February, 1919. A month later he was sent home with a hospital unit to spend the spring and summer of 1919 in Fort Sheridan Hospital, near Chicago.

"The platers of Chicago treated me nobly while I was at Fort Sheridan," said Mr. Rushton. "They made me feel right at home in the city and many of them had me at their homes many a time. *Frank Hanlon, Oscar Servis, Fred "Dad" Liscomb, Jock Lockerbie, Jake Hay* and others certainly treated me fine. During the hospital period I would hear from St. Louis in letters from *E. T. Musick, H. P. Richards* and others."

He was discharged from the hospital on September 13, 1919. Again came that characteristic deep chuckle as Mr. Rushton laid aside the discharge papers on which he had been checking a date.

"September 13 is correct," he said. "Yes, I was broke again. Same as in 1907. Thirty-seven years old, still single, no job, and quite, quite busted."

Becomes Salesman

The matter of a job was easily attended to. In accepting it, however, he said farewell to the shop side of the electroplating business and entered the selling end. He became a salesman for A. P. Munning Co. of Chicago and was assigned territory including his old stamping ground, St. Louis and surroundings. At the A.E.S. convention in Philadelphia in September, 1919, he renewed acquaintance with Dr. Blum and learned of the latter's efforts to draft him into the job in the Bureau of Standards two years previous.

Six months after joining the staff of A. P. Munning Co., Mr. Rushton married *Miss Sue Thurmond* of St. Louis. The marriage endured with mutual happiness for both until Mrs. Rushton's death in Los Angeles, September 30, 1939.

In Mexico

Mr. Rushton spent two years of the early twenties in Mexico. In July, 1920, he was sent to Mexico City to install a plating plant for Fabrica Las Globes, a bed manufacturing firm. The assignment was intended as a routine one, but lasted until June, 1922. This was due to the internal difficulties with which Mexico was torn. Revolutions, banditry, graft and corruption, Mr. Rushton explained, involved an ordinary business transaction in so much red tape and delay that it took 1½ years to get delivery at Mexico City of materials laid down on the docks at Vera Cruz.

Returning to St. Louis in June, 1922, he accepted a position as Chicago factory representative for Lasalco, Inc., St. Louis manufacturers of plating equipment and supplies. He was in charge of the Chicago territory for a year. In June 1923, he came to Los Angeles for his health and continued as representative for the same firm. He holds that position to this day.

Mr. Rushton "batched" for a short time after his wife's death last fall. Since the first of the year he has shared quarters with *Ronald Clark*, a friend and war buddy. They live in what Mr. Rushton describes as "comparative comfort for bachelors" in a one-story bungalow at 2209 Reservoir St., in the Echo Park district of Los Angeles where he and his wife had resided for many years.

Mr. Rushton is active in American Legion affairs, being chaplain of Echo Park Post No. 414, and in the American Electroplaters' Society, in which he holds office as vice-president of Los Angeles Chapter. Gregarious by nature, he likes the goodfellowship incidental to association activities, and is a regular attendant at Legion and A.E.S. meetings.

"Years ago," said Mr. Rushton in reviewing the events of the passing years, "practically all the final operations at polishing steel and iron were felt-wheel coloring. A common practice today, prior to nickel plating, is to copper plate, then buff, which *does* hide polishing finish defects and produces a high luster with a consequent high luster on both finished nickel and chromium jobs. Yet it is the finish under the plate that determines the lasting quality of the plate, and felt wheels or some substitute for final coloring will sooner or later come into vogue again.

"Had I been asked years ago how much plate I had on my work I would have said, 'One hour at two volts, or 1½ hours at 1¾ volts' and so on. I might have been dumb (I think I had company, at that), but it was while plating on lead similar in shape to a square wire basket that I learned the value of ammeter and that voltage was a secondary consideration. This article could not be brushed, yet had to be brighter and whiter on the inside than on the outside.

One on Oscar Servis

"I learned a good lesson from a story told by Oscar Servis some years ago in St. Louis. Oscar went to work in a plating shop when he was 13 years old. There was one brass tank that plated anything but brass. The foreman made additions, couldn't find the right solution, yet blamed the help for poor brass plating. One morning Oscar happened to come to work before the others and found the brass tank had sprung a leak during the night. The tank was half empty. Oscar, figuring he would get blamed for everything that happened around the shop, got a hose and filled the tank up with water. When they started plating, the brass came out fine."

"There' said the foreman," taking credit for the accident, 'I told you I'd get that solution fixed sooner or later.'"

Oscar Servis, Mr. Rushton explained, was wise enough not to let out a peep about the water.

"During the time I have been selling," Mr. Rushton continued his reminiscences, "I've been asked to locate the causes of some trouble in the plating shop—blistering of die castings or peeling of the plate or brass, and the like. Reducing the cleaner and sometimes the plating solution was beneficial sometimes.

"Some 30 years ago polishers and platers were predicting that plating had reached the limit of development. Since that time, we all know the wonderful strides it has made, chiefly in the laboratory. Platers who know enough chemistry and how to apply their knowledge to their work have achieved the greatest success. Such men as *Charles Proctor, George Hogaboom, Dr. Blum, Oliver Sizelove, Oscar Servis, H. J. Richards* and others too numerous to mention have been leaders in this development. It is natural to assume that many other developments will follow anodic coating of aluminum, bright nickel, bright copper and other improvements that already have taken place. The young plater of today will be wise to study at least the fundamentals of chemistry. The farther he goes into that subject the farther he will advance in the plating industry, for the day of guesswork is fast disappearing."

In spite of his nearly two decades in the selling end of the business Mr. Rushton is still at heart a plater. He delights to drop in at the shop of *Marcus Rynkofs, Earl Coffin, Don Bedwell* or some other fellow member of Los Angeles Chapter and take a hand at turning out a lead flower holder or to devote an occasional day to silverplating casts. Scattered about the mantel of his home are various small pieces of recent work which attest that fact that he has lost none of the skill which made him a shop foreman at the age of 26.

"Say," he asks, "did you ever hear how *Oscar Servis* and *Frank Hanlon* liked those fake newspaper headlines I got out about them when they were in Los Angeles this spring?"

It seems that when Messrs. Servis and Hanlon arrived from Chicago they were presented with a fake newspaper bearing a bold, black streamer reading: SERVIS AND HANLON COMING TO HOLLYWOOD.

After the 1940 Educational Session had been completed and Servis and Hanlon had departed from Los Angeles, Mr. Rushton had a second fake newspaper prepared, which he sent to the secretary of Chicago Chapter: The headline read: SERVIS AND HANLON ARRESTED.

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A Pickling Racket

★ **By Theodore Eichstaedt** ★

Detroit, Mich.

The *Pickling Racket* perpetuated and worked by one Dr. Niemo away back in 1889 and 1900 with quite some success financially to himself. I do not know how long he worked this racket, but I do know that he traveled in style, stopped at all of the first-class hotels in the country at cities where polishing and plating was being done.

There were not so very many traveling men selling polishing and plating supplies at that time and the few who did were well known to the trade, and most of them were fine upstanding men. With some exceptions they were generally fairly well posted in the practice of the trade and well thought of.

There was no A.E.S., in fact, there was no special publication for the plating industry. Consequently, it was a time when an electroplater was considered a sort of "Mystery Man," making metal stick to other metals and making all sorts of oxidized finishes and it was a mysterious sort of work or art to the majority of people, even to those who accidentally stumbled on to a peculiar color or finish and many times could not reproduce these colors or finishes.

How Doctor Niemo started his racket I do not know, but it was a real racket and I will try to relate my impressions of just how he worked it.

I do not know whether or not he had a diploma or a degree as a Doctor of Medicine or Chemistry. All I know he traveled in first-class style: high plug hat, Prince Albert coat, patent leather shoes, fancy waistcoats and cane, with a small case such as physicians carry for their instruments, and a buttonhole with a carnation or some other flower in it, and he smoked 10 or 15c cigars constantly. He always picked the first-class hotels in every place he stopped.

His racket was to sell the purchasing agent or superintendent or whoever he knew was the highest man in authority of the company upon whom he called. By the way, he always had a pair of the best livery stable horses, a Surry or Phaeton, whichever he could hire and a driver or coachman. His business looked most professional and it did not take long to close a deal.

As stated before, it was selling a formula for pickling cast and malleable iron and steel. At this time, stampings were not very generally used in the manufacturing industry, consequently, a real pickle was in fact quite an adjunct to the polishing and plating industry at this time. It was something every plater should have. Dr. Niemo knew this and as his professional appearance made an impression and his title of "Doctor" also made its impression on the prospective customer, he, Doctor Niemo, would get the confidence of the prospect and finally in a secretive way, making as much of a mystery of it as possible and impressing the customer so much with the idea of secrecy that he, the customer, even had to promise not to divulge the formula to anyone or the source of his procuring it or how much he paid for it.

I certainly give him credit for his sales abilities, but I do not condone his methods. Except that he did know how to put the sale over to the individual customer and he gained their confidence enough for anything from $25 to $200 for the formula. (Result:) The customer who bought the formula kept it in the safe. Then in a day or two after Dr. Niemo had sold him, he, the purchaser, would call on or call in the foreman plater and read it, the formula, to him and ask him to make it up and follow instructions of procedure of the pickling process. In a great majority of cases, the plater already was using just such a formula for pickling, but because the purchaser and his superior had promised to keep it confidential where he obtained the formula and also told the foreman of the promise of secrecy; he, the foreman was pledged to it before he ever got it from him. Thus even if the plater knew it was the same as he had, he would not divulge it to his superior.

Finally one plating foreman told his superior who had purchased the formula for $100 that he had been using it for years and it at last became generally known of this racket Dr. Niemo had put over. But not before Dr. Niemo had sold practically every stove manufacturer in this country a copy of the formula and had cleaned up a small fortune by doing it.

You see the idea of secrecy was the real thing that helped him put it over for Dr. Niemo. Many who purchased this formula are still alive and will read this, will have a real laugh on himself. Thus, there are many who after realizing how they had been duped never told anyone of it. It is very easy to estimate that 100 of these formulas at $100 each is $10,000. Quite a year's salary at that time and not bad for a racket in those days. (*Aye Wat?*)

But there are a few men still traveling and calling on the plating trade with different formulas and processes by which they can dupe the purchasing agent, superintendent or manufacturer, but I do hope that the manufacturers and job plating companies have confidence in their plating foreman to have any kind of a formula or process talked over with him and be safe-guarded against any "Rackets."

Beware of any *Dr. Niemo.*

(Oh, Yes! The formula was a 15% solution of sulphuric acid and water used either hot or at room temperature.)

PLATING AND FINISHING
POLISHING — BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

SHOP PROBLEMS

Plating Safety Pins

Q. I would like to learn the complete cycle, from start to finish, for the plating of safety pins. Would it be better to copper or brass plate previous to nickel plating?

Safety pins can be finished as follows:

1. Clean to remove oil and dirt. This can be done by tumbling in sawdust, or solvent dipping and then tumbling in sawdust. Follow with an alkaline cleaner. Rinse. (Pins are closed).
2. Roll in weak hydrochloric acid to remove rust and oxide. Basket dipping may be used if scales are not too heavy. Rinse.
3. Roll in soap and water, no steel balls, for 30 to 60 minutes. Use a steel barrel and roll until a fair luster is obtained. Rinse.
4. Immerse in alkaline cleaner, to remove soap film. Rinse.
5. Immerse in 10% sulfuric acid solution.
6. Barrel nickel plate, nickel direct, no brass or copper first.

A 50 lb. load of work will draw about 120 amps., at 6 volts. Plate for 30 to 45 minutes in the following solution:

Single nickel salts	18 ozs.
Ammonium chloride	3 "
Boric acid	3 "
Water to make	1 gal.

pH 5.8 Room temperature.

A cadmium stick is hung on the anode rod to add cadmium to the solution for a bright, dark colored nickel as required by the trade. Excess brightener is avoided by removing the cadmium stick at intervals.

7. Rinse.
8. Roll in sawdust to dry.

—G. B. H., Jr.

Breaking of Plated Springs

Q. We manufacture small malleable iron parts in which a small steel spring of 0.156" x 0.018" cross section is fabricated. After the cadmium plating operation we are experiencing more spring breakage than after nickel plating.

Is there any method to correct this breakage? If by heat treating, we would like to know of a source of detail procedure.

A. The difficulty which you are experiencing is due to hydrogen embrittlement. Hydrogen gas is given off during cadmium plating and to a smaller extent, in nickel plating and usually the amount of embrittlement is correlated with the amount of hydrogen codeposited with cadmium or nickel being plated.

The amount of hydrogen discharged and absorbed would be dependent upon the length of time of plating, the current density and the efficiency of the solution. The absorption is also dependent somewhat on the hydrogen overvoltage of the metal being plated, and for example, it has been found that chrome steel springs are more susceptible to hydrogen embrittlement than plain steel springs.

Lessening of this difficulty can be done in several ways:

1. First of all, the solution composition should be checked and adjusted to give the highest efficiency.
2. Relatively low current densities (10 amperes per sq. ft.) should be used to enable the use of the highest possible efficiency.
3. Acid pickling should be as short as possible and in fact, where bright steel is burnished, no pickling is used. The use of an inhibitor in the acid is recommended.
4. Do not use cathodic electrocleaning. Cleaning anodically or without current is better.
5. After plating, the springs should be baked in an oven operated at from 300° F. to 350° F., for about 2 hours. The temperature used should be just below the temperature at which relief of strain occurs in the steel, so that warping does not take place.

A treatment in boiling hot water has been recommended but it has been found that this treatment does not drive off all the hydrogen contained in the spring. The baking treatment will protect the springs from breaking due to hydrogen embrittlement. However, if the springs are cracked in the plating process by failing to follow the first four suggestions, then the baking treatment will be of no value because the cracks will be already in the steel.

The harder the steel and the greater the stress in the spring, the greater the susceptibility to hydrogen embrittlement. The breaking usually occurs in the part of greatest stress.—W. R. M.

Technical Advisors For October Issue

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Steel Knife Blades

Q. We would appreciate receiving any information that you may be able to furnish on steel knife blades suitable for use in sterling silver dinner knives.

A. Blades for sterling silver dinner knives should be made from stainless steel of the so-called straight chrome type. The exact steel used should be judged from the point of view of ease of working in manufacturing processes, corrosion resistance, final lustre and finish capable of being applied, and ultimate hardness and ability to retain a cutting edge.

Unfortunately, concentration on any one of these properties usually involves a little sacrifice in another so that the steel selected must involve a compromise. Thus increased edge-retention, by using a higher carbon steel, does not permit the same degree of mirror finishing.

A good steel for the above purpose contains 0.3-0.4% carbon, 12-15% chromium, 0.2% silicon and 0.35% manganese. A harder blade with better cutting edge is obtained if these figures are higher. Maximum corrosion resistance depends on proper hardening and thorough grinding and polishing to remove scale and surface blemishes or inclusions.

The above considerations should be kept in mind when purchasing either the blades or the material for making the blades. Any of the well-known steel companies may be consulted for the names of blade manufacturers in your neighborhood.

—N. E. P.

Hot Tinning of Brass

Q. I would like to secure information on hot dip tinning. The article that I want to dip is made of brass and will come in contact with distilled water.

A. The first essential treatment of any metal to be hot-dip tinned is to see that it is perfectly clean and free from any oil, grease or other foreign material that may be on the surface. Even if there is no actual oil or grease that can be seen, it is good practice to give the castings a dip in a good commercial cleaning bath. Since cleaning baths are alkaline in character, this should be followed by thorough, cold and hot water rinses.

Some castings may have fine sand embedded in the metal surface so that the next step is to be sure that all such sand is entirely removed. Hydrofluoric acid is the only acid that will attack and dissolve sand so that this pickle should be made up of a mixture of 1 gal. of water to about 24 ozs. hydrofluoric acid. This acid evaporates very easily so that the bath temperature must be fairly low; 100° to 120° F.

The next step is to rinse the castings well in clear, clean hot water. Since brass contains copper, the pickle must contain nitric acid. A suitable pickle is a mixture of nitric acid, sulphuric acid, muriatic acid and water. Making up this pickle requires care. Pour very slowly 1 gal. of 66 deg. sulphuric acid into 2 gallons of 38 deg. nitric acid. One ounce of muriatic acid is poured into a pint of water, and this is then very slowly poured into the mixture of nitric and sulphuric acids. Extreme care should be taken in mixing the acids; do it very slowly and very carefully. This mixture is then used for pickling brass castings. The castings should be held in the acid pickle until the surface of the casting is clean, then removed and again be thoroughly washed in running water.

After pickling, the next step is fluxing properly. The flux solution can be zinc chloride with some white, powdered sal-ammoniac added to it, or it may be zinc ammonium chloride made up to almost a saturated solution until the flux is tacky or sticky. The castings are dipped in this liquid flux solution and then are drained well on a drain rack ready for tinning.

The size of the tin pot should be judged according to production requirements. If the production is large and the pot and bath small, the tin will be quickly overheated and ruined. A good brand of soft Straits tin should be used. Hard tins should be avoided. Particular care should be taken in the heating of the tin bath since overheating once to a marked degree will ruin the tin for further use. Therefore, it is of vital importance that the operation be controlled by an electric recording pyrometer. The bath temperature should not be guessed.

The metal tin melts at 449° F., and since a high tin bath temperature will tend to dissolve the casting, the bath temperaure should not be over 500° F., the lower the better. If this temperature does not give the desired lustre to the tin coating, the temperature may be raised a little higher, to say 520° F., with an absolute upper limit of 550° F. This range should be high enough to give a clean bright coating with a good lustre. The tin bath is well covered with a zinc chloride flux to a depth of about half an inch. It should not be so deep that it cannot be thoroughly brushed aside to allow the clean withdrawal of the castings from the bath.

The castings should be left in the tin bath until all quivering ceases, and small particles of flux no longer rise to the top of the bath. This indicates that the work has come to the same temperature as the bath and that the surface is entirely coated or covered with molten tin. The article is then slowly withdrawn from the bath, while at the same time the flux is kept away from the article with a skimmer. When withdrawn clear of the bath, the castings are plunged into a bath of kerosene oil surrounded by a cold running water bath. In some plants the quench is hot water with about an inch or more of kerosene oil on top of the water. The inlet and outlet are both below the oil level so that the water is carried off without also carrying away the oil. After the quench of the coating, the work is dried in sawdust, and then the sawdust is blown off with high pressure air.

If the work is to be put on a production basis, the tin pot must be very large and the equipment must be placed in a suitable manner under a monorail. The work can be handled in and out of the cleaning and pickling baths, flux, etc. in baskets, but care must be taken that the castings are always totally submerged in the various liquids, as exposure to the air causes corrosion to rapidly take place over the exposed surface.

The hydrofluoric acid on a small scale can be used in a small lead lined cypress wood tank; on a large scale, the tank should be acid proof brick lined with carbon brick facing. The nitric acid should be handled in an acid proof brick tank and since nitrous fumes are developed, this tank should have a hood over it to carry off the brown, choking fumes. The castings must be well washed after the operations in each tank, as solution contamination by carrying the liquid from one tank over into another, quickly causes endless troubles that make it necessary at times to empty out and make up all entirely new solutions before the trouble can be eliminated. This care is well worth while. As mentioned also, tin readily dissolves brass when too high a temperature of the tin bath is used, and this not only destroys the tin in the bath by contamination, but also ruins the work. For this kind of work as low a temperature as possible should be used, and the bath should be operated entirely with the use of a pyrometer so that the bath temperature will be known at all times. One bad overheating of the tin bath will ruin it so that the entire bath may have to be replaced.—W. I.

Russian Gold

Q. Kindly send us a formula for making Russian gold and also how to use it on lead and white metal pieces.

A. Russian gold is a modified name for the antique green gold smut solution. To produce the finish, a smutty dark deposit is first obtained using the following formula:

Sodium gold cyanide (71% metal)	10 dwt.
Cadmium oxide	½ "
Lead acetate	5 grains
Sodium cyanide	1 ounce
Water	1 gal.

Temperature 80° F., 3 volts, stainless steel anodes. After plating in the above solution, the smutty deposit is relieved with moist sodium bicarbonate to clear or brighten the high spots, making a distinct contrast against very dark green background. Lacquer is then applied making the finish darker.

If the finish obtained does not appeal, it can be shaded in the regular 24k. red gold or green gold solution to the desired color; then lacquer.

To plate white metal articles, the work should be cleaned in a suitable solvent to remove oil and polishing compounds if any, then cleaned in a mild alkali cleaner, brass or copper plate using low current densities, then plate in the Russian gold solution as mentioned.

There are base metal compounded salts on the market that produce a dark smutty deposit, eliminating the cost of gold considerably, where the proper shading gold solution is only required.—P. A. O.

The shop problem service is not intended to be a routine, free analytical service. Advice is freely given on problems which cannot be solved by the inquirer. Only simple plating solution analyses will be made free of charge.

ELECTROPLATING DIGEST

SELECTED ABSTRACTS ON PLATING—FINISHING—RUST PROOFING—LACQUERING

Anti-Pitting and Brightening Agent

U. S. Patent No. 2,195,409. *L. H. Flett, assignor to National Aniline & Chemical Co., Inc. April* 2, 1940. An addition agent for plating solution of nickel, cadmium, copper, gold, iron, lead, silver, tin, zinc and cobalt, consisting of a mixture of alkyl aromatic sulfonates of the benzene series in which the alkyl groups correspond with aliphatic hydrocarbons of petroleum distillates boiling above 170° C., and which are obtainable by halogenation of the petroleum distillate, condensation of the resulting mixed alkyl halides with an aromatic hydrocarbon of the benzene series and sulfonation of the resulting mixed halides.

Adherent Silver Deposits

U. S. Patent No. 2,195,231. *W. J. Weber, assignor to General Electric Co. March* 26, 1940. A process for producing adherent silver coatings on copper contact points by first depositing a film of mercury electrolytically instead of by the usual immersion or "blue dip". The solution contains:

Mercuric chloride	1.5 ozs.
Sodium cyanide	4 "
Ammonium chloride	2 "
Water	1 gal.

An iron tank is used, also functioning as the anode. A uniform deposit of mercury is formed on previously cleaned copper in about 3—5 second at 10—15 amps./sq. ft. It is only necessary to plate in the mercury solution until complete coverage is secured since any excess mercury will fall off. After the mercury coating has been applied, the object is rinsed and silver plated.

Bright Dip for Metals Electronegative to Iron

U. S. Patent No. 2,194,498. *G. Dubpernell & K. G. Soderberg, assignors to the Udylite Corp. Mar.* 26, 1940. A process for bright dipping metals electronegative to iron and belonging to the second sub-group of the second group of the periodic system, comprising immersion in a solution of chromic acid and a catalyst in the form of sulfate radical and maintaining the ratio of CrO_3:SO_4 below a critical value of about 20:1, or an equivalent ratio of chromic acid to an acid radical so that a discolored film is produced on the surface. This film is then removed by immersion in a caustic solution with a concentration of approximately 4.25 normal to saturation, at room temperature for a period not exceeding 15 min.

Disposal of Waste Cyanide Solutions

U. S. Patent No. 2,194,438. *C. J. Wernlund and M. J. Zunick, assignors to E. I. duPont de Nemours & Co. March* 19, 1940. The cyanide content of the waste solutions is reduced below 4 parts per million by treating under alkaline conditions with a substance selected from the group consisting of elemental sulfur and water soluble compounds having sulfur in the polysulfide form to form thiocyanates. Sulfur and slaked lime or calcium sulfide may be used. Temperature is preferably at boiling and above 80° C. in general. Time required is from 3 minutes to 2 hours depending on the temperatures and the methods. Enough sulfur is added to provide an excess of about 5—10% over the amount theoretically required for removal of the cyanide. Enough lime should be added to keep the solution alkaline during the full course of the reaction.

Blackening Ferrous Alloys

U. S. Patent No. 2,192,280. *E. A. Walen and F. W. Wilbur, March* 5, 1940. A process for coloring ferrous articles black by oxidizing in two stages by immersion in the usual nitrate-caustic solution, the concentrations being such that the solution in the first stage has a boiling point about 20°—25° F. lower than the second. The potassium salt is used for one of the constituents preferably and the sodium salt for the other. The ratio used is 2 parts of caustic to 1 part of nitrate. For example:

First stage:

Caustic-nitrate mixture	7.75 lbs. approx.
Water	1 gal.

Second stage:

Caustic-nitrate mixture	9.25 lbs. approx.
Water	1 gal.

The first solution boils about 285°F. and the second about 310°F. Articles are immersed for 5—15 minutes usually in each solution, then rinsed and oiled for protection.

Bright Nickel

U. S. Patent No. 2,191,813. *H. Brown, assignor to the Udylite Corp. February* 27, 1940. A method of depositing fine-grained, lustrous nickel from a solution comprising essentially a standard nickel plating solution plus additions of soluble organic compounds containing the group $-SO_2.N=$, such as sulfonamides and sulfonimides, in a concentration of from 0.1 gram per liter to saturation, the solution being operated between pH 2 and pH 6 electrometric. The solution may contain a zinc salt in an amount corresponding to less than about 0.3 grams per liter of zinc. Also may use formic, furoic and fluoboric acids in the solution instead of boric acid. A table listing the various brighteners in the above-mentioned class or group is given in the patent specifications.

Coloring Steel Black

U. S. Patent No. 2,202,531. *V. T. Malcolm, assignor to the Chapman Valve Mfg. Co. May* 28, 1940. A process of coloring steel black and producing a corrosion resisting coating by immersing the article in a solution containing substantial amounts of sodium hydroxide and water and relatively small amounts of sulfur and phosphoric acid. Example:

Water	100 grams
Caustic soda	100 "
Sulfur	1 gram
Phosphoric acid	5 grams

Immerse at about 270° F. for about ½ hour. Coating is about 0.001—0.003 inches thick. Coated articles withstood 72-hour salt spray.

Selenium Bath

U. S. Patent No. 2,202,532. *V. T. Malcolm, assignor to the Chapman Valve Mfg. Co. May* 28, 1940. A selenium bath made by dissolving ferroselenium in sulfuric acid, making the resultant solution alkaline by adding ammonia and then slightly acidifying by adding nitric acid. To be used at 6 volts and 2.5 amperes/ft.^{2} Deposit claimed to prevent galling and seizing of austenitic steel surfaces.

Acid Pickling Inhibitor

U. S. Patent No. 2,176,389. *R. L. Brandt, assignor to Colgate-Palmolive-Peet Co.* October 17, 1939. Inhibitor obtained by extracting petroleum products with liquid sulfur dioxide and treating the extract with a sulfonating agent while dissolved in liquid sulfur dioxide.

Fundamentals of Science Relating to Electroplating

There is one other property of atoms which is of extreme practical importance which should be discussed before leaving the subject. That property is atomic weight. It has been said that the mass and weight of an atom are primarily due to the nucleus. While such absolute weights are far too small to be determined by direct experiment, they may be computed. Thus, referring to hydrogen, there are over 600,000,000,000,000,000,000,000 atoms to the gram. Of more practical importance however, are the relative weights of atoms. For reasons which need not be discussed here, all relative weights are referred to oxygen as having a value of 16.000 and are commonly known merely as atomic weights. Table 1 gives such weights for the common elements.

Since these are relative weights, they are not, of course, expressed in any units such as grams. The figures merely mean that the oxygen atom, for example, is 16 times as heavy as the hydrogen atom. These relations do *not* apply to the metals in bulk, such as that pure iron is a little over twice as heavy as aluminum. For all practical chemical calculations, only these relative figures are used.

Because of the possibility of variations in the composition of the nucleus of an atom without affecting its net electrical charge or the net structure of the atom, it is possible that atoms of the same element may have somewhat different atomic weights. Elements which have identical chemical properties but which differ in atomic weight are called *ISOTOPES*. A familiar and popular example is "heavy hydrogen" which goes to make up the so-called "heavy water." The determination of many of the isotopes is of fairly recent date, as in the case of hydrogen, and the figures given in atomic weight tables are, in reality, average weights in those cases where isotopes exist. For all practical computations, however, such variations in atomic weights may be ignored, although some of the properties of the purified isotopes may in time develop into practical importance.

3. *The Molecule and Combinations of Elements*

The mechanism by which elements combine to form other materials has always been an intriguing problem. From the days of ancient Egypt and Babylonia down through this very day, theories have been offered, built up, and knocked down, only to be rebuilt, very often with an undercurrent of old thought but always in

This is the second chapter in the series of articles relating to the fundamentals of science which pertain to electroplating. The introductory chapter which appeared in the September issue of Metal Finishing discussed the structure of the atom.

new words and with new expressions. In ancient days they spoke of two working forces, one active and one passive, one male and one female, the former symbolized by the Sun and the latter by the Moon. In the sixth century B.C., the Chinese talked of Yang and Yin where Yang was a donator, masculine and positive, and Yin was a receiver, feminine and negative. Today we talk of positive ions and negative ions, one donating an electron and the other receiving it, its offspring, the molecule of a new compound.

In the previous installment, the *molecule* was introduced as a possible intermediate stage or unit in the formation of matter from atoms and, in truth, the molecule is always made up of atoms, held together by mechanisms to be presently described. Two or more atoms of an element may be united to form a molecule of that element. Such a condition is common in the gases. Oxygen, for example, as it is usually known, exists as a mass of oxygen molecules, each of which contains two oxygen atoms. Molecules containing three atoms of oxygen may also be formed and in this particular state it is known as ozone, the very active oxidizing agent the peculiar odor of which is so prevalent in the neighborhood of high tension electrical equipment.

When the atoms of a molecule are not alike, then of course a material is formed which differs in properties from either of the elements represented by the atoms. Thus sodium is a metallic element which reacts violently with water. Chlorine is a gaseous element which is poisonous and obnoxious in odor. Yet when one atom of sodium chemically combines with one atom of chlorine, one molecule of sodium chloride is formed which has neither the properties of sodium nor chlorine, being merely common table salt. Sodium chloride is called a *compound*, as opposed to an element. Compounds are substances which are uniform in composition throughout and which are made of elements always combined in the same specific proportion by weight. In the example of sodium chloride, 23 parts by weight of sodium will combine with only 35.5 parts by weight of chlorine. Having defined a compound, we may define the molecule of a compound as the smallest part or unit of that compound that can exist and retain the properties of the compound.

There is often confusion in the conception of chemical compounds and mere physical mixtures of elements. There is hardly a better example than the classic one of mixing very thoroughly and intimately sulfur and iron filings. The resultant color is a blend of the sulfur yellow and the iron grey. The individual properties of the elements are still retained. Thus iron may be separated from the mixture by a magnet and acts just as it did before. The sulfur may be dissolved out in carbon disulfide which may then be evaporated leaving the original element. Now if this mixture is heated, a chemical reaction takes place and a compound, iron sulfide, is formed. This compound has neither the properties of iron nor of sulfur. The iron cannot be removed by a magnet nor the sulfur with carbon disulfide. An entirely new material has been formed and not merely a blend of the constituents. Another example that illustrates the difference between compounds and mixtures is gunpowder. Gunpowder is merely a mixture of carbon, sulfur and potassium nitrate. As such it is harmless and innocent enough, but when it is fired, this mixture reacts to form compounds, most of which are gases and therefore take up hundreds of times the original space. This sudden expansion of the confined gases constitutes the "explosion". The atoms and elements in the compound are the same as those in the mixture but what a difference their combination makes!

Compounds and mixtures really represent the extremes of combinations of elements. As so often happens, there exists a region in between in which it is difficult to say which term should strictly be applied. This region is of particular interest to us because it is populated primarily by metals in the form of *alloys*.

A metal alloy, in other words, consists of two or more metals so intimately admixed that their mutual relationship may be, but is not necessarily, as close and interwoven as that existing in a true compound. Furthermore, this intermediate type of combination is not restricted to metals, for alloying may similarly take place between a metal and a non-metal, such as between a metal and hydrogen. Let us consider, for example, the situation in nickel plating, where the cathode current efficiency is not 100%. Hydrogen is, therefore, codeposited with the nickel.

Some of this hydrogen is very loosely held by the nickel, but some of it is very closely combined with it, we might say as a nickel-hydrogen alloy. Thus when electrodeposited nickel is heated, at least in some cases, hydrogen gas is given off in increasing quantities until a temperature of 400°C (752°F) is reached. This is the loosely held, "mechanically occluded" hydrogen, corresponding in a sense to hydrogen "mixed" with nickel. From 400°C to 800°C (1472° F) very little happens, but above 800°C, hydrogen is again rapidly given off. This hydrogen is the chemically bound gas, the "alloyed" hydrogen.

The question of the mechanism by which the atoms are held together in a molecule was casually mentioned above and it is now of interest to investigate this more carefully. We may roughly divide the possibilities into three types and shall consider each one separately.

In the previous article we discussed the electron shells of an atom and said that under stable, steady conditions the outer shell was satisfied when it contained a certain specific number of electrons, the number depending on the particular element. Let us consider, as an example, those elements for which this stable number is 8 and let us suppose that in one such element, the atom actually has in the outer shell only seven electrons and that in another such element there exists an extra electron outside the group of 8. If these two atoms get together, one can correct the condition of the other by giving up the excess electron in one case and taking it on in the other case, so that both have their stable outer groups of 8. In so satisfying each other, the original atoms form molecules. In accomplishing this, the atom that sacrifices an electron becomes positively charged (with one unit charge) and the atom that gains the electron becomes negatively charged (with one unit charge). It is the mutual electrostatic attraction between these two charged atoms that holds them together to make the molecule. The charged atoms are called *ions*, in one case a positive ion and in the other case a negative ion, and the compound resulting from the molecule thus formed is therefore called an *ionic compound* or *polar compound*. It is the Sun-god and the Moon-goddess again, alias Yang and Yin, to a certain extent historical thought repeating itself in modern clothing.

By way of an example of the above, an atom that may become a positive ion is sodium, and one that may become a negative ion is chlorine, since the sodium atom has one single electron outside its stable shell of eight and the chlorine atom has only seven electrons in its outer shell. Because of the unit charge possible, sodium is said to have a combining value of +1 and chlorine is said to have a combining value of —1. The combining value of the atoms of an element is called the *valence* of that element. Now instead of there being a surplus or a deficiency of only one electron, the number may be two or three and so forth up to eight. It is even possible to treat the atoms of certain elements in such ways that sometimes they have one value of valence and under other conditions a different value. Such conditions we shall discuss in a later article. All the metals have a positive valence. Table II gives the possible values of valence for the elements of interest to us at this time. Included also are certain combinations of elements which are very stable and which occur very frequently. These combinations are called *radicals*. They exist only as ions and cannot therefore be isolated as such. The subscript, such as 4 in SO_4, means that four atoms of oxygen are combined with one atom of S.

To simplify expression, an element with a valence of 1 is called monovalent, with a valence of 2 is called divalent and with a valence of 3 is called trivalent (as in trivalent chromium). There are similar names for the other values.

It is quite obvious that in ionic compounds, atoms must combine so that the total positive valence equals the total negative valence. In the case of sodium chloride, a valency of +1 combined with a valency of —1. Should it be desired to form calcium chloride, two atoms of chlorine (to give a total valency of —2) must combine with one atom of calcium (which has a valency of +2). On the other hand, since the sulfate radical has a valence of —2, one unit of the radical combines with 1 atom of calcium. Similarly, the valences are balanced in all molecules. Other phases of this subject will be discussed below.

So much then for the first type of compound, the ionic or polar compound.

The second type of bonding in molecules occurs in those cases where the atoms available cannot correct each other's deficiency or excess in electrons, as the chlorine atom took over the excess electron of the sodium atom to build up its own group of 7 to a figure of 8. In the absence of a sodium atom, two chlorine atoms could each supply an electron to be shared, so tha each atom would have 6 electrons exclusively its own and two electrons shared with each other. The total would still satisfy the requirement of 8 for the stable outer shell and this is in fact the mechanism by which a chlorine molecule is formed. Such molecules are called *homopolar* of *covalent*, the words indicating molecules made up with bonds that are similar, instead of opposite as in the case of ionic compounds. The common gases in general exist mostly as diatomic (two atom) molecules constructed as above, and are always fighting to exist in the atomic form (called *nascent*) in which form they are very active chemically. Thus hydrogen as it is first formed at the cathode is atomic, combines in pairs of atoms to form molecules of hydrogen, which then "coalesce" to form hydrogen bubbles, which then too often proceed to annoy the plater by causing streaking or pitting.

We come finally to the third type of bonding of atoms, which is the type existing in metals. It is not as easy to depict this mechanism of bonding as in previous cases for there is no simple combination or sharing of electrons taking place. Essentially, however, the bonding in metallic atoms is still due to a sharing or cooperative effort. Consider any metallic atom such as sodium. There is only one electron free for combination (called a valency electron). It cannot very well take the electron from seven other sodium atoms, which would result in an unstable molecule. Also, since there is only one valency electron, there are not enough valency electrons available in each atom for double sharing to make a total of eight as done in the homopolar molecules. Therefore each valency electron must serve for a number of atoms. The liberation of these electrons we have seen forms positive ions so that the metallic state may be pictured as a grouping of positive ions tied together, through electrical attraction, by liberated (free) electrons. These electrons account for many of the properties peculiar to metals, such as electrical conduction, certain thermal properties, etc. The description and explanation of these properties are best left for a later discussion, to avoid digressing too much from a consideration of molecules as such.

Just as we considered, under atoms, atomic weights, so we can consider at this time molecular weights. The *molecular weight* of a compound is the sum of the atomic weights of the atoms in a molecule of that compound. As in the case of atomic weights, the figures obtained are merely relative and do not refer to any unit such as ounces or pounds. Thus to go back to our original example of sodium chloride, in which 23 parts by weight of sodium combined with 35.5 parts by weight of chlorine, obviously the molecular weight is equal to the sum of these two figures or 58.5. Obviously too, in sodium chloride, sodium comprises 23/58.5 of the total weight or 39.3% and chlorine comprises 35.5/58.5 or 60.7%. In this way the percentages of constituents in a compound can be computed, provided the combining ratio of the atoms is known, i.e. the number of atoms of each element that are used to make the compound. This latter factor, we have already seen, is determined by the valence of the elements. See the examples which follow.

It is convenient to introduce at this stage a system of chemical abbreviations or shorthand. Each element may be designated by a *symbol*, which is usually an abbreviation of its name. Thus zinc is written Zn, sulfur is written S, etc. Many of the symbols are based on the Latin or Greek names such as lead, Pb, from the Latin "Plumbum". The origin of some of these names is often interesting and descriptive of some of the properties of the element.

(To be continued in November issue)

Post Scripts

One Negro was worrying about the chance of his being drafted for the army. The other consoled him. "There's two things that can happen, boy. You is either drafted or you ain't drafted. If you ain't you can forget it; if you is, you still got two chances. You may be sent to the front and you may not. If you go to the front, you still got two chances, you may get shot and you may not. If you get shot, you still have two chances, you may die and you may not! And even if you die, you still has two chances."

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It is very difficult to use a dictaphone for chemical dictation unless the operator is familiar with technical terms. *Ray Shay* of the Lancaster Branch, A.E.S., must have used a machine in dictating the announcement regarding *Dr. Ken Graham's* talk on quote: "Electro-Light Films". Anyway, as shown at the talk, the electrolyte films were "light" in metal at the cathode.

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If one peruses old volumes of the Monthly Review, Transactions of the Electrochemical Society or Metal Industry, it will be noted that we are re-discovering new things every day. We are reprinting in this issue a paper by *Prof. Wilder Bancroft,* which deals with blue gelatine-copper films, that appeared in the 1912 Transactions of the Electrochemical Society. The paper appears to be interesting and worth re-discovering.

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Leslie Linick of Linick, Green and Reed, Chicago, Ill., recently informed us that the much needed metal tin has been discovered in a territory at least 100 miles long and at least 25 miles wide between Custer, South Dakota and Thermopolis, Wyoming. Molybdenum has also been reported in that section of the country. Hope it's true as it will mean much to the U. S.

+

Rudy Hazucha is in the news again and rightly. Rudy is with the Clinton Co., Chicago and is renowned as a bowler and golfer, and most recently on the 14th of Sept. was congratulated for his record of attendance at every regular meeting of the Chicago Branch, A.E.S., since its founding 25 years ago.

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We expect shortly to place a wreath on a file of letters and conduct obsequies on the same. These letters are dead letters to which no answer was received. I suspect answers were never received because of some of the following reasons: the recipient never answers letters; he is too busy; he can't write; Jim Farley's henchmen lost the reply; the P. A., Mailing Dept., or Manager forget to give him the letter, etc. Some day we hope to conduct a poll on the reasons for failing to answer letters and I am sure many of you will be interested in the results.

Happy attendants at the Newark Branch A.E.S., held at Vogel's Grove, Union, N. J.

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When Hoover was defeated in 1932, folks were rather timid about wearing buttons with "Hoover" on them. When Landon was trying to crack the New Deal, sunflower buttons were seen to some extent. But now one almost feels naked unless he is wearing a Willkie (or Roosevelt) button. A New York publication recently and rather cleverly depicted this condition by a cartoon showing an elderly gentleman calling: "Did you send my pajamas to the laundry with my Willkie button on them?"

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Frank Rushton introduced a new and simplified method of speech making at a meeting of Los Angeles Chapter. According to the secretary's mimeographed announcement, Mr. Rushton was to "deliver an address on the functions and values of the Ampere-Hour Meter."

"Who am I to paint the lily?" said Mr. Rushton as he rose and unfolded a four-page factory circular. "The advertising expert who wrote this circular writes better English than I can talk . . . So here goes."

His "address" consisted of reading the circular, with an extemporaneous "Thank you, gentlemen," at the close.

Smiling Rudy Hazucha who attended every Chicago Branch A.E.S. meeting for 25 years.

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Did you know that *E. Steen Thompson* of Erie, Pa., a member of the Cleveland Branch, A.E.S. and Past Supreme President of the A.E.S. is an excellent photographer both in color and black and white; that *Corliss Powell* of Dayton actually looks like Dick Powell of movie fame; that 133 years ago *Sir Humphrey Davy* used electroplating of fused salts to isolate the elements sodium and potassium. He became deliriously joyful when metallic globules of potassium appeared at the cathode of electrolyzed fused potash.

+

In a biography of *Wilfred S. McKeon* (Sulphur Products Co.) that appeared in a Pittsburgh publication, it stated in the conclusion that Wilfred claimed to be 29 years old. We then did some hasty calculations and concluded that Mac was 13 years old when he helped found the International Fellowship Club in 1924. I think Mac meant that he felt 29 years old.

+

Congratulations to the American Cyanamid & Chemical Corp. for making thiourea and potassium cyanide thus making us independent of European sources for these chemicals.

Walter R. Meyer

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

New Variable Speed Polishing Lathe

Chas. F. L'Hommedieu & Sons Co., 4521 Ogden Ave., Chicago, Ill., announce the development of a new type of variable speed polishing lathe, called "No. 24". It is made in the bench type as well as pedestal type, having a speed ratio of 3 to 1, which is said to be most suitable for small work, requiring various speeds, for Butler finish, polishing, buffing or exceptionally high speed with small buffs.

This new lathe will be on exhibition at the National Metal Exposition in Cleveland, Ohio, in October.

Shaker Separator

Ace Engineering & Machine Co., 3644 N. Lawrence St., Philadelphia, Pa., have announced a new product called "Ace Shaker", which is recommended for separating sawdust, emery, burnishing balls, etc., from small parts.

The separation is said to be accomplished in from 20 to 30 seconds, in contrast with a 3-minute hand job.

The shaker uses a standard 18″ sieve that can be removed and easily emptied. It produces a rotary oscillating movement that is said to produce a thorough agitation without dead spots.

The unit is completely enclosed allowing no sawdust, water, etc., to get into moving parts. The sawdust or abrasive falls into a drawer at the bottom.

The shaker is driven by a 1/3 H.P. motor which can be furnished in 110 or 220 volt A.C. or D.C.

Literature is available describing this new engineering development.

Shaker separator

Bias Buffs

Bias Buff & Wheel Co., 430 Communipaw Ave., Jersey City, N. J., have announced the development of a new type of buff specially designed, according to the manufacturer, to reduce high polishing costs.

Increased polishing surface is claimed as well as the elimination of waste in both cloth and polishing compositions. This new buff is known as Type "A", and is stated to be adaptable for all classes of work.

The cloth from which these bias buffs are made is produced in the company's own cotton mills.

This new buff is an addition to a complete line of the company's buffs for use where high speeds are necessary.

Neoprene Suit

Industrial Products Co., 800 W. Somerset St., Philadelphia, Pa., has announced the development of a suit made of Neoprene (DuPont's synthetic rubber), for oil and acid use. This suit was developed to withstand oil, alkalis and the solvents that usually disintegrate natural rubber in a short time. In addition, it is claimed to be much more resistant to the effects of air and sunlight than the best of modern natural rubber compounds.

Multiple Barrel Oblique Plating Unit

Munning & Munning, Inc., 202 Emmett St., Newark, N. J., have announced the manufacture of a multiple twelve barrel oblique plating unit for plating small articles, such as screws, bolts, nuts, etc.

This unit, called the "Vari-Matic", is stated to be an economical apparatus for plating different finishes on odd lots of small work without hampering routine production.

The machine is compact, sturdy and occupies a minimum of floor space. The unit is available in 4, 6, 8 and 10 tub sizes.

Each plating barrel unit is an electrically connected separate assembly, engaging a common worm drive coupled to a gear-head motor.

The barrels are interchangeable, rotate at the same speed and at 45° elevation. They can be readily removed and replaced at will for loading and unloading. Each drum has its individual shift and jaw clutch so that it can be stopped and started independently of the other barrels by disengaging it from the drive; each drum has its own rheostat for controlling the plating current depending upon the load. The drums are made of steel, rubber lined, and each is mounted on a bronze flanged casting with a projecting sleeve which slips over a revolving head supporting the barrel and is electrically insulated from the driving mechanism so that each drum is cathodically connected as soon as it is placed in position.

The complete unit can be made ready for operation as soon as it is bolted to the floor and attached by one set of terminals to the source of plating current. It is shipped completely wired for service and requires only that the proper anodes for different solutions be suspended from the positive conductor bar, which is situated directly over the open ends of the line of plating barrels.

Special shaped anodes are not required because sections cut from standard oval anodes are entirely satisfactory.

The tubs on the machine pictured are 10½″ deep, 7½″ diameter at the mouth and 6½″ diameter at the bottom. They contain a copper contact disc in the base, fastened by brass bolts to the bronze supporting flange which slips over an electrified brass sleeve at the top of each revolving head. The plating current is led into the buckets through insulated copper rods running to the sleeves through the drive shafts direct from mercury wells at the opposite ends of the intermediate assemblies. The conductors are ample in

Professional Directory

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Solution analysis, plant design, process development. Testing of deposits—composition, thickness, porosity, salt spray.
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Any plating solution analyzed for $1.
Reagent solutions for analyzing 25c. pt.
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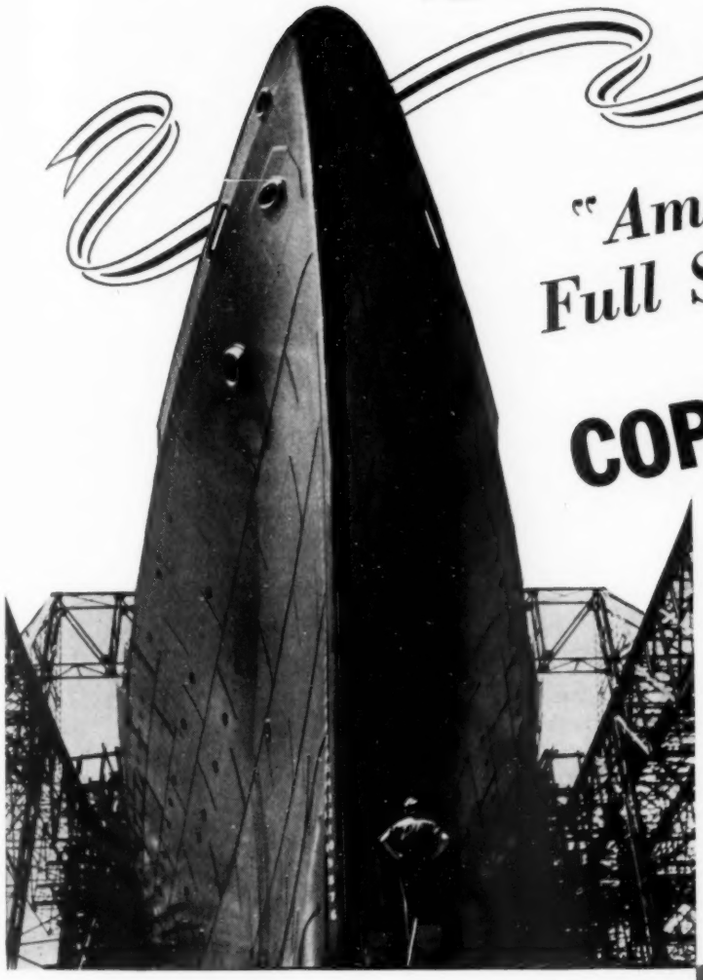
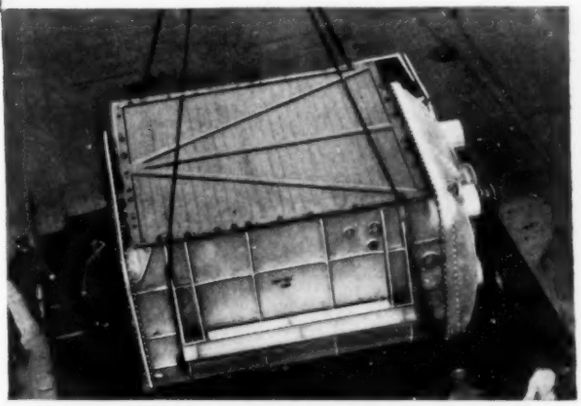


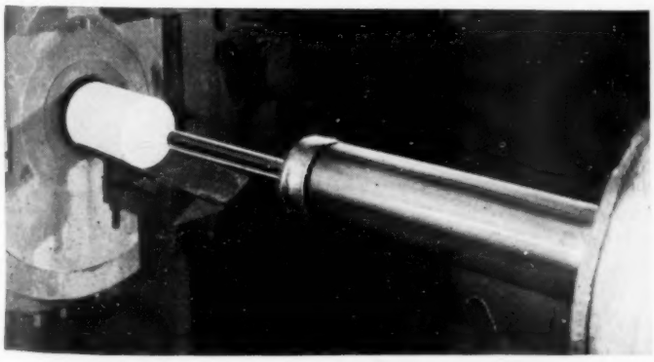
"America" Goes Full Steam Ahead!

with COPPER-NICKEL condenser tubes

The new S.S. "America" symbolizes metallurgical and ship-building advancement. Alloys will increase her efficiency and reduce operating and maintenance costs. Nickel alloyed irons, steels and non-ferrous materials are widely used in numerous applications from pumps to plumbing fixtures, windlass shafts to steering rams, from bulkhead fittings to compass rigs . . . each Nickel alloy chosen for the job it does best.

Two main and two auxiliary condensers in the "America" employ 130,000 lbs. of 70/30 Copper-Nickel tubes. These corrosion-resistant Copper-Nickel tubes are not subject to the type of corrosion known as dezincification. This Copper-Nickel alloy forms a light protective film which assures high resistance to corrosion, erosion and impingement attack. Main condenser tubes, all produced by Revere Copper and Brass, Inc. are 14′3″ long, ¾″ in diameter and 1/16″ thick. Nickel alloyed materials provide uniformly high physical properties at low cost per year.





Copper-Nickel of 70/30 composition fabricates readily, an advantage which is reflected in its moderate price. The Copper-Nickel alloys are highly ductile yet retain full strength and toughness when pierced, drawn or extruded. Here a hot Copper-Nickel billet is being pierced in the Revere plant, first step in forming improved condenser tubes. Your consultation is invited regarding marine applications of materials strengthened and toughened with Nickel.

(Photos courtesy Revere Copper & Brass Inc.)

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

STAINLESS STEEL POLISHING COMPOUNDS

Are Proven Every Day in Every Kind of a Metal Working Plant

"4-A" Polishing Compounds Are Faster, More Efficient, More Economical for Polishing, Mirror Finishing of All Kinds of Steel, Including Stainless Steel and Other Alloys.

Use it on any kind of a wheel, soft, hard, medium. Results will speak more eloquently than anything we could say.

Tell us about your toughest job,–and we'll be glad to send the "4-A" product that will solve your problem. No obligation, of course.

CEMENT AND THINNER

Instead of glue, use "4-A" Cement and Thinner, a uniform substitute for polishing Wheels, Belts, Buffs, Rolls, etc.

Samples of Compound or Cement sent on request.

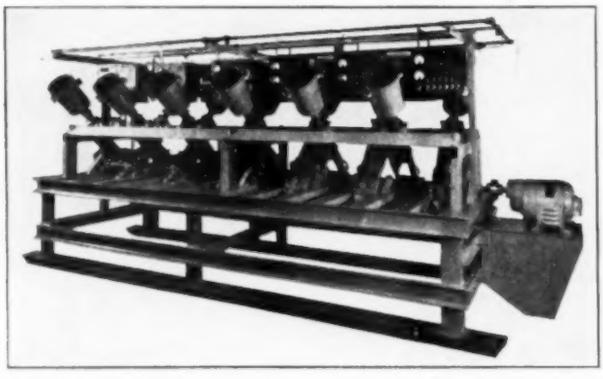
HARRISON & COMPANY

HAVERHILL, MASS.

capacity for the current required and positive contact is always effected.

The unit is said to be sufficiently substantial to accommodate buckets at least twice as large as those illustrated, and the mechanism can be constructed so that the containers can be tilted for emptying purposes if necessary.

The Vari-Matic operates quietly and smoothly. It contains ball thrust bearings for supporting the load, as well as oilite radial bearings. The drums rotate at 7 R.P.M. but other speeds can be obtained if specified. The interior of the buckets may also be ribbed for turning the work over during rotation if their nature is to nest. The frame of the machine is fabricated from structural steel with a welded plate motor bracket, all of sufficient strength to eliminate vibration.



Plating unit for small parts containing 12 oblique barrels

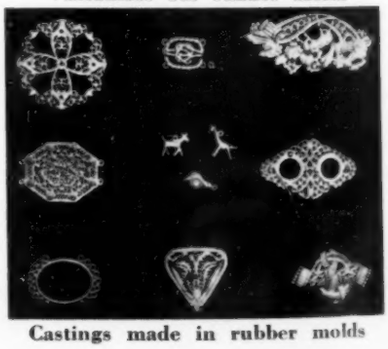
Rubber Molds for Casting White Metal Alloys

The Alrose Chemical Company have developed a new process for casting white metal for novelty and jewelry items. This process consists in using rubber molds, which are said to reduce mold costs to less than one-tenth the cost of the bronze molds previously used.

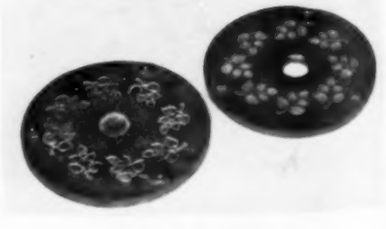
This development enables novelty and jewelry manufacturers to offer a wider variety of high quality items in unusual designs, in the low price range. The molds, made of newly developed rubber compounds, are made by placing the models or samples to be duplicated between rubber blanks which are then compressed together to produce the casting cavity. Models may be of any metal and do not require drafting, and undercut items may be readily produced.

The hardened rubber mold is suitable for casting metals having a melting point up to 700° F. on a production basis. From fifteen to one hundred gross of castings, it is claimed, can be produced from a mold costing less than $5. Perfect reproduction is assured, according to

Vulcanizer for rubber molds



Castings made in rubber molds



A rubber mold

the manufacturer, by use of centrifugal force to distribute the molten metal. The resulting castings retain fine detail, have smooth texture and are free from blowholes. From one to seventy-two pieces may be cast simultaneously in one mold, depending upon size. The entire process can be set up and operated in a space 60" x 60".

Process and casting machine are available from the Alrose Chemical Company, Providence, R. I.

Dust and Spray Hood

Industrial Products Co., 800 W. Somerset St., Philadelphia, Pa., have designed a dust and spray hood to provide practical respirator and head protection against dust and spray operations. The hoods are manufactured of a specially

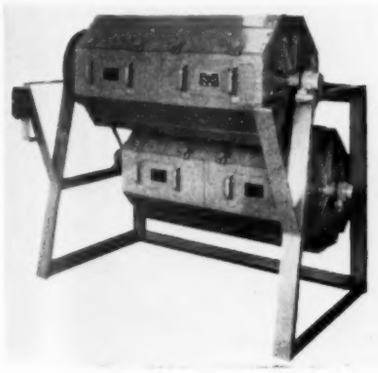
Dust and spray hood

selected strong weave cloth, fitted with the respirator and laminated safety lenses in demountable rings. They are patterned to fit comfortably and may be taken completely apart for washing, if necessary. All parts are replaceable.

Rotary Finishing Barrel

Crown Rheostat & Supply Company, 1910 Maypole Ave., Chicago, Ill., are exhibiting at the National Metal Exposition, Cleveland, Ohio, a new type double cylinder "Roto-Finish" barrel.

This barrel has been designed especially for the new Sturgis Roto-Finish process, which is a tumbling process for finishing die castings and stamped metal parts of stainless steel, brass, etc.



Double cylinder rotary finishing barrel

It is said that, in many cases, a finish equal to that of a hand-buffed finish can be obtained. One of the main features of the barrel is the ease of loading and unloading all four compartments. The units are available for dry finishing and for wet finishing, both types of units being on display at the Metal Show.

Stainless Clad Mixer

One of the recent pieces of equipment fabricated from Jessop Silver-Ply stainless-clad steel is a mixing tank built by L. O. Koven & Bros., Inc., Jersey City, N. J. It can be used for mixing liquids with other liquids; or with dry or semi-wet solids to produce syrups, emulsions, creams or pastes.

Walls of the tank were made from Type 306 Silver-Ply plates manufactured by the Jessop Steel Co., 545 Green St., Washington, Pa. These particular plates consist of .086 in. of stainless steel cladding inseparably united to 0.351 in.

Stainless clad mixer

50 YEARS OF CHEMICAL EXPERIENCE

BACK OF EVERY WYANDOTTE PRODUCT

Airplane view of J. B. Ford Sales Company plant and portion of Michigan Alkali Company plants at Wyandotte, Michigan.

Most men who work with metal know that when they buy a Wyandotte Product they are taking a big step toward solving their metal-cleaning problems.

Most men who work with metal know that back of every Wyandotte Product there is a large and active service organization.

What may not be realized is that every Wyandotte Cleaning Product has behind it one of the world's largest manufacturers of basic chemical products—the Michigan Alkali Company.

The chemicals manufactured by Michigan Alkali are the basic materials from which, since its beginning, The J. B. Ford Sales Company has been making its complete line of Wyandotte Products.

A Wyandotte service representative will be glad to demonstrate what these products can do for *you*.

Wyandotte

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99.75% PURE

Stocks of Mutual Chromic Acid are available in all principal industrial centers, where Mutual distributors stand ready to give complete technical service supplemented and supported by the research and development facilities of the world's largest manufacturer of chromium chemicals.

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MUTUAL CHEMICAL CO. OF AMERICA
270 MADISON AVE. NEW YORK
PLANTS AT BALTIMORE AND JERSEY CITY MINES IN NEW CALEDONIA

of mild steel backing; however, Silver-Ply sheets and plates are supplied in practically any degree of cladding desired.

Silver-Ply was specified for the new mixing tank because the stainless cladding (on inside of tank) provides the same permanent protection from contaminations as solid stainless, while the mild steel backing lessened material costs and made fabrication easier. The tank can be jacketed to heat or cool its contents during mixing, and the superior heat conductivity of Silver-Ply was found desirable should this be necessary.

Complete information on Silver-Ply stainless-clad steel for use in processing equipment may be obtained from the Jessop Steel Company.

Face Shield With Replaceable Window

A new face shield with a plastacele window that slides in and out of a fibre frame, making replacement practical at a fraction of the cost is announced by The Boyer & Campbell Company, Detroit.

Besides simplifying replacement the fibre frame is said to afford considerably more face protection than the conventional metal bound type. This frame is interchangeable on all models of B & C face shields except 10 and 20, making of the No. 40 "four and one" a "five and one" instead. The "five and one" are:

(1) The New Fibre Frame with replaceable plastacele window, which is ideally adapted to spot, flash, and gun welding, buffing, polishing, wire brushing, etc.; (2) A 24-Mesh Monel Screen Window recommended for babbitting, heat protection, heavy scale, band sawyers, etc.; (3) Fibre Front and Glass Holder that gives complete protection for acetylene welding, burning, scarfing, etc.; (4) Fibre Crown and Rubber Apron, which gives broad protection for acid workers; (5) The Conventional type of metal bound plastacele window.

Face shield with replaceable window

IS YOUR BRAIN CHILD

a Wall Flower?

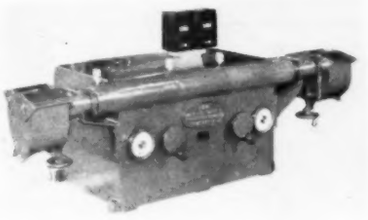
Give it a touch of glamour and beauty with one of these stripes, scorings, crimpings or corrugations. The change will actually bring you production savings. Completely *pre-finished*, American Bonded Metals can be drawn, stamped, formed or assembled into your completed product. Elimination of plating—either before or after fabrication—polishing or buffing brings substant production savings. Write on your company letterhead for a new brochure showing the latest in *pre-finished* metals, designs, patterns and ideas.

AMERICAN NICKELOID COMPANY
8 SECOND ST.—PERU, ILL.
Sales Offices in All Principal Cities

New Polishing Lathe

Rome Machinery Sales & Engineering Co., 627-35 Webster Street, Rome, N. Y., have placed on the market their new model "2AS" polishing, buffing and grinding lathe.

Covering a wheel spindle speed range from 1800 to 7000 RPM, this model is equipped with independently driven wheel spindles through 3 HP motors. Each speed adjusting hand wheel, conveniently operated from each wheel position, is combined with an automatic speed indicating dial. Arranged with a 24" height from floor to center of wheel spindle, to permit operators working on the top of wheels, this machine is adapted to the hand processing, by grinding, polishing or buffing of a wide variety of cutlery, jewelry, hardware and miscellaneous small tools.

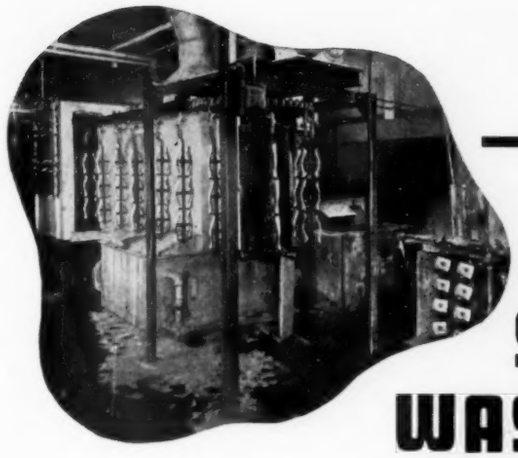


New polishing lathe

To obtain the ultimate in safe operation, all drive mechanisms are effectively enclosed and are accessible for servicing through a detachable door at the top of the motor compartment. All spindles operate on special, heavy duty ball bearings which are assembled in dust tight housings.

Wheel guards illustrated are fabricated from heavy gauge steel and are adjustable to compensate for wheel wear and also may be pivoted around the wheel center to any convenient operating position.

The weight of the machine, complete with motors and motor starting switches, is 2400 pounds.



For
SPRAY WASHERS
Lively Action METSO Cuts Costs!

METSO CLEANERS keep step with speed production holding rejects at a minimum. The reason rests in the able-bodied alkalinity in Metso which is balanced with silica. This combination lifts the grease, leaving metal parts *chemically* clean.

Metso is so thorough that one large plater, formerly copper plating before nickel, on steel, eliminated the copper, and had a better plate directly with nickel.

Put Metso to work on your particular problem. Further information without obligation.

Metso Cleaners Manufactured Exclusively by

PHILADELPHIA QUARTZ CO.

EST. 1831 General Offices and Laboratory: 125 S. Third St., Philadelphia, Pa.
Chicago Sales Office: 205 W. Wacker Drive. Metso stocks in 60 cities.
Sold in Canada by NATIONAL SILICATES LTD., Toronto, Ontario

METSO CLEANERS

Variable Speed Buffing and Polishing Machine

The Standard Electrical Tool Company, 8th & Burns Street, Cincinnati, Ohio, have recently developed an Infinitely Variable Speed Buffing and Polishing Machine to serve any and all requirements of buffing, polishing, coloring, etc. The current speed for each operation can always be obtained, using any size or type wheel. Further, longer wheel life and more efficient production is insured, with an additional saving being reflected in that worn wheels no longer have to be discarded.

The change in speed is accomplished quickly and easily, merely by turning hand wheel conveniently located at top of machine. Each change of spindle is shown in revolutions per minute on the indicating dial at front, and while the full speed range is 1000 RPM to 3500 RPM, the Speed Changer can be set for any immediate speed range desired.

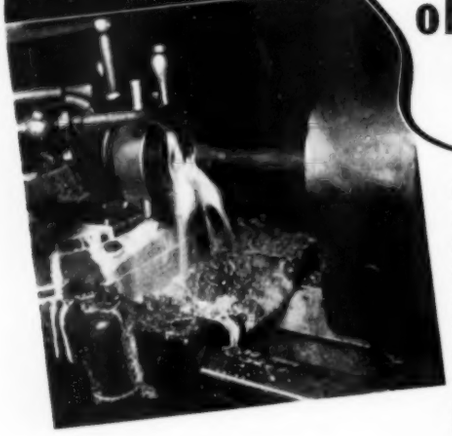
All of the equipment, including Speed Changer, constant speed 1800 RPM Ball Bearing Motor and Magnetic Starter, is enclosed inside substantial base, while the Push Button Station is located at front of machine. Removable louvered covers at sides and front and a large removable cover at top front, provide easy access to inside of base.

Variable speed buffing and polishing lathe

Features of construction include high grade nickel steel spindle, with hard bronze spindle nuts, four heavy duty ball bearings and liberal oil reservoirs, with visible oil supply. A shaft lock is also provided for use when changing wheels.

Available in 3, 5 and 7½ HP sizes, with larger sizes furnished to order, this Infinitely Variable Speed Buffing and Polishing Machine is said to incorporate simple construction and easy operation, with quiet and smooth performance. The straight front pedestal permits the wheels to extend beyond the machine proper, allowing ample freedom of operation and foot room.

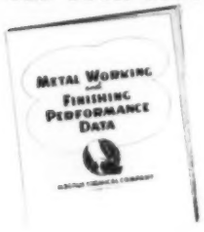
So... It's a Perfect Lubricant & Coolant... But Does it Wash off Readily and Well?



Much needless expense, delay and difficulty in maintaining quality standards are due to the often overlooked fact that a great many perfectly good lubricants are mighty hard to remove.

Think of the finishing operation when you buy your cutting, grinding and machining lubricants. Make sure that the materials you use will wash off readily and well.

GET YOUR COPY



Ask us to send you a copy of performance reports on this and other Magnus Specialties for Metal Forming and Finishing. They are full of useful and practical ideas.

MAGNUS EMULSIBLE OIL AND BASE

offer you not only the opportunity of making up such lubricant coolers to meet your exact needs, but of cutting considerable amounts from your lubricating costs. Emulsible Oil Base, mixed with the proper viscosity mineral oil will give you an emulsible cutting and grinding oil of high quality which is very easy to remove. Emulsible Oil is an excellent lubricant already compounded with the Base and a 27 Be' mineral oil, ready for use, in water mixture.

MAGNUS CHEMICAL COMPANY

Manufacturers of Cleaning Materials, Industrial Soaps, Metallic Soaps, Sulfonated Oils, Emulsifying Agents and Metal Working Lubricants.

11 South Avenue Garwood, N. J.

MAGNUS CLEANERS

A new bulletin fully illustrating and describing this equipment, is now available from the manufacturer and a copy will immediately be mailed on request.

Manufacturers' Literature

Colorimeter. Spencer Lens Co., Buffalo, N. Y., in a 4-page folder describe their direct result colorimeter. This instrument allows direct reading of the percentage of the unknown and featured advantages include inclined eyepiece, simple adjustment of light, and tilted plungers for dissipating air bubbles.

Finishing Barrels. Globe Machine & Stamping Co., Cleveland, Ohio, have issued a 12-page bulletin describing their finishing and tumbling barrels. These barrels include open tilting type barrels and various closed barrels. Photographs illustrate various makes of barrels and specifications for these barrels are included.

Finishing Performance Data. Magnus Chemical Company, Inc., Garwood, N. J., have issued a bound booklet of reports, briefly summarized from performance data, supplied by users of the company's materials. They give a picture of the results obtained, particularly with reference to past practice. These include cleaning parts before organic finishing, cleaning before vitreous enameling, cleaning after quenching, and after galvanizing. Case histories on specific subjects, such as cleaning manicure files, machine screws, jewelry, novelties, etc. are given.

Insulating Joints. Catalog 280 of Barco Manufacturing Co., 1801 Winnemac Ave., Chicago, Ill., describes the company's insulating joints for pipe lines to cleaning and plating tanks for steam, water and other fluids. Illustrations are given of typical installations.

Pre-Finished Metals. American Nickeloid Co., Peru, Ill., have issued a series of bulletins describing uses for pre-finished metal. Some of the uses include ovens, flashlights, ash trays, metal boxes, lamps and carpet sweepers. Testimonials are given from users of pre-finished metals.

Letters From Our Readers

CLEANING OF ZINC

MacDermid Incorporated

Waterbury, Connecticut
September 6th, 1940

Dr. Walter R. Meyer
METAL FINISHING
New York, N. Y.
Dear Dr. Meyer:

I read with considerable interest your editorial comment on the recent work of Oplinger with reference to the causes of blistering of die castings under heat. I believe the industry as a whole believes that over cleaning is the prime evil. However, there is some difference of opinion as to what constitutes over cleaning.

I agree that 2 ounces per gallon of trisodium phosphate or sodium carbonate can over clean but it does not necessarily follow that any alkaline material over 2 ounces per gallon will get the same poor results.

It is also true that by doing a perfect job of degreasing it is possible to clean with ½ to 1 ounce solution of TSP. However the chances of a shop getting this perfect job in degreasing operation is rather slight. The manufacturers of degreasers are constantly improving their equipment but it is not my belief that the thorough efficiency has reached a point where it is advisable to recommend such a low concentration of alkaline cleaning compound.

During the past six months new materials have been developed that make reverse cleaning of die castings a commercial success and puts new light on the meaning of over cleaning. While it is possible to over clean with TSP at 2 ounces per gallon cathodically, it is perfectly possible to get a good cleaning job

(if the cleaning material is compounded correctly) at a concentration as high as 10 ounces per gallon, temperature 200 degs., F., current density 40 amps. per sq. ft.

The cycle that seems to be giving excellent results is an alkaline pre-soak at 6 ounces followed by a spray cleaner at 1 to 2 ounces and this in turn by a 6 to 8 ounce reverse alkaline cleaner.

In commenting on the findings of Oplinger I think it is in order to mention some recent developments as noted above that throw a new light on over cleaning and adherence of nickel to die castings at high temperatures.

Very truly yours,
MacDermid Incorporated
Harold Leever
Western Manager & Chemical Eng.

*

I doubt whether Oplinger implied in his paper that no cleaners could be used in concentrations higher than ½ to 1 oz. per gal. He found this concentration to be best when using trisodium phosphate. The concentration of cleaner, current density and length of cleaning time must obviously be correlated with the type of material used. It is interesting to note that at the Dayton Convention, Lewis found that anodic cleaning, when properly done, insured excellent adhesion of the subsequent plate, and Oplinger on the other hand, found cathodic cleaning to be satisfactory under certain conditions.

Probable reasons for the marked increase in diffusion, due to true overcleaning, are outlined in the editorial appearing in the August 1940 issue of METAL FINISHING.—Ed.

Protecting Car Finish

Sept. 12, 1940.
Twin Palms,
Clearwater, Florida.

Dear Dr. Meyer:

The attached short article entitled "Dew, Not Sunshine, Blamed For Failing Auto Finishes" was clipped from the Tampa Tribune, September 11th.

I have commented upon the dew, not sunshine, as being blamed for failing auto finishes. Mr. Blakeslee's (the author) contentions are interesting, but I feel sure that dew is not the answer to the oxidizing influence that produces the dull, lifeless auto finishes that may be seen by the hundreds here in Clearwater. This is also true for the entire Florida peninsula.

I have made quite a study of this problem and have found its solution. Black enamels are the only ones that withstand the action of the intense ultra-violet rays of the sun in southern Florida. Delicate colors based upon the chromic oxides are more susceptible than other basic colors.

To carry out my experiments, I purchased on January 13th this year, a ——— DeLuxe Six, finished in an aquamarine blue; a beautiful finish but I knew from constant observation the past three years that all such finishes become dull and unsightly, even though waxed by adopted methods. On January 31st, my discovery, "Ren-O-Vo" was applied to the enamel as well as all chromium plated surfaces, to present rust and atmospheric corrosion. The finish on my car is exactly the same as when purchased in January; the chromium plated surfaces likewise are the same.

We have traveled thousands of miles including a trip to New York and New England in July, through storms, detours, mud, tar coated roads, etc., and the finish still remains as in January. It is absolutely water-proof, and does not spot. "Ren-O-Vo" is one of my greatest discoveries.

I feel that what I have written should be interesting to American readers of METAL FINISHING. "Ren-O-Vo" protects any surface from moisture or oxidation.

Regards to all the METAL FINISHING staff.

Very truly yours,
Charles H. Proctor

"WITHSTANDS ACTION OF ALL SOLUTIONS"

Says Satisfied User Of

UNICHROME* RACK COATING-W

Satisfied users of "Unichrome" Rack Coating W continue to write in praise of this new, superior rack insulating material. Letters like this one:

"The plating rack withstood the action of all solutions so well that we would like you to come here and discuss its ('Unichrome' Rack Coating W) further use with us."

or this one

"Unichrome Rack Coating W is standing up after eleven months in both the bright nickel and chromium solutions." Why are users so enthusiastic about "Unichrome" Rack Coating W? Because of its unequalled combination of advantages:—

(1) Withstands boiling cleaners and all plating solutions.
(2) Tough—withstands wear and tear of handling.
(3) Contains no ingredients harmful to plating solutions.
(4) Cuts costs—reduces frequency of recoatings.
(5) Easy to apply—"dip and force dry" method.
(6) Light in color—easy to see how well the rack is covered.
(7) Any part of rack can be recoated without recoating entire rack.

Write for Bulletin 27

Containing Complete Information

Platers without rack coating facilities may have their racks coated with "Unichrome" Rack-Coating W* by Chromium Corporation of America, 4645 West Chicago Avenue, Chicago, Ill.; Belke Manufacturing Company, 947 North Cicero Avenue, Chicago, Ill.; or Lea Manufacturing Co., of Waterbury, Conn.

UNITED CHROMIUM
INCORPORATED
51 East 42nd Street, New York, N.Y.
2751 E. Jefferson Ave., Detroit, Mich.
Waterbury, Conn.

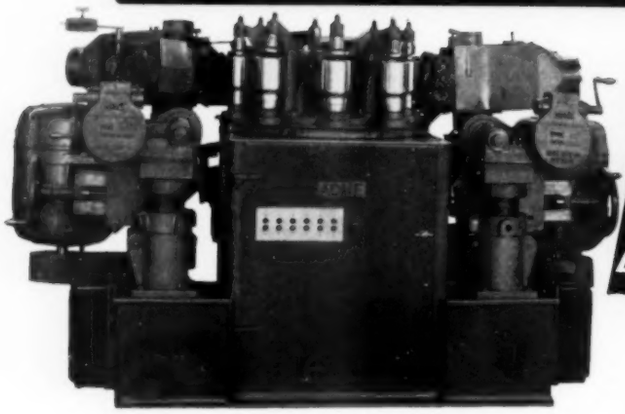
*Trade Mark Reg. U.S. Pat. Off.

New Books

Salts of the Platinum Metals and Gold. Published by Baker & Co., Inc., 113 Astor St., Newark, N. J. Size 11" x 8½"; 10 pages. Given free upon inquiry under company letter-head.

This booklet is a ready source of information on the salts of platinum, rhodium, ruthenium, iridium, osmium and gold, which information is difficult to secure in the literature. In discussing the salts of each metal, the chemical formula, molecular weight, theoretical metal percentage, color and form and solubility of the salts, are given. In addition, discus-

WHY NOT DO YOUR *Polishing and Buffing* FASTER AND CHEAPER?



SEND SAMPLE for FREE Production Estimate

Where speed is a factor in polishing and buffing, or where the problem is one of reducing production costs, Acme Automatics have a definite place.

Consider, for example, the Three-wheel Rotary Automatic, illustrated above—a heavy duty machine designed principally for cylindrical work. It does its job with a rapidity that is almost unbelievable. And, at the same time, it produces a better finish than can be obtained by any other method.

Bring your polishing or buffing problem to Acme! It may surprise you to find how easily one of the many types of Acme Automatics can be adapted to your particular needs, speeding up production and materially reducing costs.

ACME *Manufacturing Co.*
1642 HOWARD ST. • DETROIT, MICH.
Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS

Abbott

for Better plated surfaces

Prepare for a fine plate first by burnishing small, metal parts. After plating, burnish again. That rolls down the surface, closes pores, increases resistance to corrosion. Pressure does the job. Therein lies the advantage of Abbott high, narrow barrels which take a charge of several hundred pounds of steel burnishing materials. This mobile weight, confined within an upright area, develops maxir um pressure on the work. Questions gladly answered. Orders promptly filled.

The Abbott Ball Company
"Burnishing and Cutting-down Barrels—Burnishing Balls and Materials."
1046 New Britain Ave. Hartford, Conn.

sions are presented on the chemical properties and uses of the metal and its salts.

A table of international atomic weights is given as well as a comparison of weight measures.

Mention is made of the company's other booklets entitled: "Platinum Metals and the Chemical Industry," "Bibliography of Patents on Palladium as a Catalyst," and "Data Concerning Platinum."

The Story of Superfinish, by Arthur M. Swigert, Jr. 665 pages, size 4¼" x 7". Published by Lynn Publishing Co., Detroit, Mich.

The author is director of production research for the Chrysler Division of Chrysler Corp., Detroit. The book gives a clear and graphic picture of the story of superfinishing as developed by the Chrysler Corp.

The book is well illustrated by photographs and photomicrographs.

The beginning and reasons for superfinishing are outlined in the introductory chapters, then follow an exposition of surface finish nomenclature and methods for measuring surface finishes. Methods for producing superfinish are described and illustrated in detail and this is followed by a discussion of the metallurgy and engineering advantages of superfinishing.

The book amply fills the need for a presentation of this subject to the public to enable a thorough understanding of the mechanics of the process and its advantages and applications.

Silver in Industry. Edited by Lawrence Addicks. Published by Reinhold Publishing Corp., 330 W. 42nd St., N. Y. City. 624 pages, size 4½" x 7". Price $10.00.

A very comprehensive study of the metallurgy of silver. The book is a collaboration of prominent metallurgists and opens with a discussion of the background of silver by Lawrence Addicks and then follow discussions on the properties of silver, binary silver alloys, and the technology of silver.

Commercial aspects of silver and its alloys are given in detail such as the use of silver for bearings, electroplating, as a catalyst, as a fungicide, etc. The bibliography is very complete and for convenience is arranged according to subject matter. A comprehensive patent survey is appended.

Technical Literature

Table Internationale des Poids Atomiques (International Table of Atomic Weights). Dixieme Rapport de la Commission des Poids Atomiques (10th Report of the Commission on Atomic Weights 1940). Address, General Secretary 28, Rue Saint-Dominique, Paris, France.

Recent investigations on the atomic weights of seven elements, as well as a complete table of the atomic weights of 1940, are given.

The book is printed in three languages, namely, English, French and German.

Table Internationale des Isotopes Stables (International Table of Stable Isotopes). Cinquieme Rapport de la Commission des Atomes 1940 (5th Report of the Commis-

sion on Atomic Weights 1940). Address, General Secretary, 28 Rue Saint-Dominique, Paris, France.

New researches on isotopes are given and the isotopes of all the elements as known today are tabulated. Printed in English, French and German.

Hairlining of Sheet Steel Enamels. By B. J. Sweo. Published by Technical Staff, Ferro Enamel Corporation, Cleveland, Ohio.

A discussion of hairlining of sheet steel enamels with photomicrographs and drawings to illustrate the text.

Business Items

The Hanson-Van Winkle-Munning Company, Matawan, N. J., manufacturers of electroplating equipment and supplies, are expanding plant facilities. Due to the unprecedented demand for their electroplating equipment, they have started construction on a new addition to their plant, 66 ft. x 39 ft. built of steel and hollow tile, with concrete floor. This building will house a 10-ton crane.

Harry C. Bernard, announces that he entered into the manufacture of industrial cleaning compounds last January, and established a plant for this purpose at 399 MacDonough St., Brooklyn, N. Y., doing business under the name of "Bernard Chemical Products."

Specialized metal cleaning compounds, soaps and solvents are among the items offered to the electroplating and metal finishing industries, most of which are compounded to meet individual metal cleaning problems.

Harry Bernard is well known in the electroplating and metal finishing fields, having been for several years a plating superintendent. He was also one of the original group who helped form the National Electro-Platers' Society of U. S. and

Harry C. Bernard

IS THE DAY TOO SHORT?

Save Time By Sending Your Solutions To Us For Analysis. Immediate Accurate Report By Air Mail.

NICKEL SOLUTIONS
Nickel, Chlorides
Boric Acid, pH
COPPER SOLUTIONS
Copper, Free Cyanide
Carbonates, pH
ACID COPPER
Copper, Sulfuric Acid
$1

ROCHELLE COPPER
Copper, Rochelle salts
Free Cyanide,
Carbonate, pH
BRASS SOLUTION
Copper, Zinc, pH
Free Cyanide,
Carbonate
$1.50

Other Solutions & Other Ingredients At Equally Low Prices
Send a 4 oz. Bottle by Parcel Post or Prepaid Express

KOCOUR CO.
4724 S. CHRISTIANA AVE. • CHICAGO

★ ★ ★ SPECIALISTS IN SOLUTION CONTROL ★ ★ ★

Largest Plating Tank in any Chicago job shop

Photograph Courtesy Hub Plating Works, Chicago, Ill.

LARGE TANKS LIKE THIS

BOTH BIG AND SMALL PLATING TANKS OF ALL TYPES

LINED WITH PERMA-LINE RUBBER

Sulfur free and particularly adapted to bright nickel and silver plating.

PERMA-LINE RUBBER PRODUCTS CORP.
2225 W. Grand Ave. Chicago, Ill.

For Wider Range of Oxidized Finishes

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McKEON'S

"Liquid Sulphur"
TRADE MARK REG.

"The Oxidizing Agent of Today"

EFFICIENT — ECONOMICAL — EASY TO USE

SULPHUR PRODUCTS CO.
Greensburg, Pa.

Let's boost Boston's A. E. S. Convention June 9-10-11-12

Any SIZE OR SHAPE

Cast or Rolled

HUSSEY

PURE COPPER ANODES

Fast, uniform deposits, less tank-time, fewer kilowatt hours, freedom from discoloration and blemishes . . . these advantages speed your operations using Hussey Copper Anodes. Available in any size or shape, cast or rolled pure lake copper. Order your supply from the nearby Hussey Warehouse.

C. G. HUSSEY & CO.
(Division of Copper Range Co.)
Rolling Mills & General Offices: Pittsburgh, Pa.
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Canada, which later became the American Electroplaters' Society, of which he is still an interested member.

Mr. Bernard's experience in the industrial cleaning field dates back to 1917, since which time he has held two important positions, first with Oakite Products Inc. for fifteen years, then with Magnuson Products Corp. for over five years.

Gehnrich & Gehnrich, Inc., 32-32—57th St., Woodside, N. Y., are erecting an addition to their building. This firm makes industrial ovens for lacquering, enameling, japanning and other industrial uses.

The Falk Corporation, Milwaukee, Wisconsin announces the election of *M. A. Carpenter* as Executive Vice President and as a Director.

Mr. Carpenter is a native of Milwaukee, receiving his early education there and higher training at the University of Wisconsin at Madison.

He has been associated with the Falk Corporation for the past 16 years, starting in the Advertising Department and successively serving as Advertising Manager, Sales Promotion Manager, Sales Manager, and, until his recent appointment, Secretary and Director of Sales.

Mr. Carpenter will continue to be active as Director of Sales and Advertising in addition to his duties as Executive Vice President.

The Acheson Colloids Corporation, Port Huron, Michigan, announces the addition of *Harold J. Dawe*, Ph.D. in Chemistry, University of Michigan, 1940, to its research staff. He will devote his time to investigate work on colloids. At Michigan, Dr. Dawe was a member of Sigma Xi, National Honorary Research Society, Phi Lambda Upsilon, National Honorary Chemical Society, and the Junior Research Club of the University. As designee by the University for the Acheson Colloids Corporation Fellowship Grant in colloid chemistry, Dr. Dawe's Doctoral Research was directed by Prof. F. E. Bartell, international authority.

The Solvents Recovery Service, Inc., Newark, N. J. announce the appointment of the *A.B.C. Chemical Company*, Waterbury, Conn., as their authorized agents

Al B. Crane

throughout Connecticut, Rhode Island and southern Massachusetts.

A. B. Crane, known as "Al" to his many friends in the metal finishing industry, is head of the A.B.C. Chemical Company. The service to be offered to the trade by Mr. Crane is that of reclaiming solvents and thinners from sludge, waste, wash, spoiled lacquers, etc., using the well known Lofgren process. A material saving to the users of the aforementioned materials, is claimed.

Mr. Crane has been associated with the metal finishing industry for a number of years, first in the paint field, and later becoming interesting in solvent degreasing. He organized his own company in order to become New England distributor for the *Mechanical Process Corporation*, South Orange, N. J., who have manufactured degreasing machines for a number of years under the trade name of "D'Oilers". In the past year, a number of these machines have been installed in Connecticut and Massachusetts.

One-Third of a Century of Service to American Industry

The Kirk & Blum Manufacuring Company, 2859 Spring Grove Ave., Cincin-

Sizes: 3, 5 and 7½ H.P. Equipment: Constant Speed 1800 R.P.M. Alternating Current Motor.

1000 to 3500 R.P.M. Spindle Speed

Merely turn the Hand Wheel on the STANDARD Infinitely Variable Speed Buffing and Polishing Machine to obtain any spindle speed wanted between 1000 R.P.M. and 3500 R.P.M.

Indicating Dial at front of Base immediately reflects each change in speed in revolutions per minute.

Speed range and convenient adjustment provides a REAL economy: Peripheral Speed maintained throughout life of buffing or polishing wheel; wheels may be worn to the very minimum in diameter before discarding, thus reducing wheel costs.

WRITE FOR BULLETIN 38A

Manufacturers of: Buffing and Polishing Machines, ¼ H. P. to 25 H. P. Heavy Duty Grinders up to 30" wheels, etc.

THE STANDARD ELECTRICAL TOOL CO.

EVANS AND EIGHTH STS., CINCINNATI, OHIO

nati, Ohio, is now celebrating its third of a century of business. Starting May 20, 1907 with a modest shop and an ambitious idea, the company has gradually built up and expanded. It now occupies a plant where two acres of floor space is equipped with modern machinery, much of it built for the particular requirements of Kirk & Blum. The organization numbers some two hundred men, including: a research and engineering staff; draftsmen; sheet metal artisans; and field erecting crews.

Kirk & Blum has specialized in the planning, fabrication, and erection of dust control systems, ventilating and cooling systems and, since 1924, industrial drying and baking ovens.

The company has issued several booklets illustrating its products and installations in various lines of industry. These, available to interested industrial executives on request, are: "Blower Systems for Woodworking Plants"; "Dust Collecting Systems in Metal Industries"; "Fan Systems for Various Industries"; "Cooling Systems for the Glass Industry"; "Industrial Ovens".

Ernest Hatch Wilkins, President, Oberlin College, announces the Senior and Junior winners of the Mercer awards. The Senior award was made to *Richard Hirshberg* for an essay on the subject of "Corporate Reorganization and the Chandler Act." Mr. Hirshberg was the Junior winner in last year's contest. The Junior award was made to *Virginia Cole* whose essay was on the subject of "The Danube Dilemma."

These awards represent approximately a semester's scholarship in Oberlin College given each year by *Col. A. L. Mercer*, President, Cowles Detergent Company, Cleveland. The Senior award is made to the individual writing the best essay on some economic subject in connection with economic stabilization. The Junior award is made to the Junior writing the best essay on some economic subject having to do with World Peace.

Hartford Steel Ball Co., 12 Jefferson Ave., West Hartford, Conn., has awarded contract for a small factory addition of approximately 5000 sq. ft.

Electric Products Co., 1725 Clarkstone Rd., Cleveland, Ohio, plans a one-story addition, 40 x 140 ft. Cost over $65,000 with equipment.

Samuel Kirk & Son, Inc., 25th St. and Kirk Ave., Baltimore, Md., manufacturer of silverware and plated ware products, have completed a one-story addition to their plant. Cost close to $40,000 with equipment.

At a recent meeting of the Board of Directors of the *Despatch Oven Company*, Minneapolis, Minnesota, the following officers were elected:

A. E. Grapp, President & Treasurer
H. L. Grapp, Vice President & General Manager
F. H. Faber, Vice President & Sales Manager
G. C. Keyes, Vice President & Chief Engineer
G. M. Lund, Secretary & Comptroller

It was noted at the midyearly meeting that the progress of the Despatch Oven Company had fulfilled all anticipations. Further progress for the balance of the year including a number of important research projects was outlined.

Dayton Rogers Mfg. Co., Minneapolis, Minn., is erecting a one-story factory for manufacture of metal stampings in small lots. With new and special equipment, this additional floor space will practically double present production. Departments operated: drawing and stamping.

Scovill Mfg. Co., Mill St., Waterbury, Conn., brass, bronze and other metal products, has let general contract for a new boiler house, 85′ x 85′. Cost about $110,000 with equipment.

Carnegie-Illinois Steel Corporation announced today that *Frank J. Rief*, purchasing agent, Chicago district, has, effective August 15, assumed the responsibilities of all purchases for the company. Mr. Rief will continue to have his offices in Chicago. He will be assisted in Pittsburgh by *R. L. Van Cleve* and in Chicago by *H. G. Elder*.

Mr. Rief has been connected with the company for 28 years, first at the South Chicago works and since 1916 in Chicago in the purchasing department.

Mr. Van Cleve has been assistant purchasing agent, Pittsburgh district, under *Charles R. Miller, Jr.*, who recently was appointed director of purchases, United States Steel Corporation of Delaware.

Mr. Elder has been assistant purchasing agent, Chicago district, under Mr. Rief.

Magnuson Says:-

"If cleaning difficulties hold up Production —I can help you"

Magnuson Research Service studies your cleaning problem—makes a PERMAG Cleaner specifically for your work, and speeds up the output at a minimum cost and in quickest time.

For 18 years we've been solving hard cleaning problems in a varied class of industries.

Write me about your problem. No obligation for an interview.

PERMAG CLEANING COMPOUNDS

MAGNUSON PRODUCTS CORPORATION

HOYT & THIRD STS. BROOKLYN, N.Y.

Representatives from Coast to Coast. Warehouses in principal cities.
In Canada: Canadian Permag Products Ltd., Montreal and Toronto.

THE WILLIAMSVILLE BUFF MFG. CO. TRADE Est. A1 1893 MARK DANIELSON CONN.

"A1"

MAGIC letters are these in Dun and Bradstreet, and they're equally assuring on a buff wheel. Since 1893 our buffs have been known by the A1 trademark, assurance of quality and workmanship.

BUY WILLIAMSVILLE BUFFS

Supply Prices, September 29, 1940

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER:	Cast	21⅝c. per lb.
	Electrolytic, full size, 16⅝c.; cut to size	16⅝c. per lb.
	Rolled oval, straight, 17⅛c.; curved	18⅛c. per lb.
BRASS:	Cast	18½c. per lb.
ZINC:	Cast	12 c. per lb.
NICKEL:	90-92%, 16″ and over	.45 per lb.
	95-97%, 16″ " "	.46 per lb.
	99%+cast, 16″ and over, 47c; rolled, depolarized, 16″ and over, 48c.	
SILVER:	Rolled silver anodes .999 fine were quoted from 38c. per Troy ounce upward, depending on quantity.	

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, Pure, l.c.l., drums	lb.	.07
Acid, Boric (boracic) granular, 99.5%, bbls.	lb.	.053-.059
Chromic, 99%, 100 lb. and 400 lb. drums	lb.	.16¾-.17¼
Hydrochloric (muriatic) Tech., 20°, carboys	lb.	.027
Hydrochloric, C.P., 20°, carboys	lb.	.08
Hydrofluoric, 30% bbls.	lb.	.07-.08
Nitric, 36°, carboys	lb.	.06
Nitric, 42° carboys	lb.	.075
Oleic (Red Oil), distilled, drums	lb.	.07¼-.08¼
Oxalic, bbls. l.c.l.	lb.	.12-.14
Stearic, double pressed, distilled, bags	lb.	.09-.10
single pressed, distilled, bags	lb.	.085-.095
triple pressed, distilled, bags	lb.	.11¾-.12¾
Sulphuric, 66°, carboys	lb.	.025
Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.175
Butyl-normal, l.c.l., drums	lb.	.095
Denat., S.D. #1, 190 pf., 1-18 drms, wks.	gal.	.345
Diacetone, pure, drums, l.c.l.	lb.	.10
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.36
Propyl-Iso, 99%, l.c.l., drums	gal.	.41
Propyl-Normal, drums	gal.	.70
Alum, ammonia, granular, bbls., works	lb.	.035
Potash, granular, bbls., works	lb.	.0375
Ammonia, aqua, 26°, drums, carboys	lb.	.02½-.05¼
Ammonium, chloride (sal-ammoniac), white, granular, bbls.	lb.	.0521-.075
Sulphate, tech., bbls.	lb.	.035-.05
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	scarce
Sulphocyanide (thiocyanate), com'l, drums	lb.	"
Antimony Chloride (butter of antimony), sol., carboys	lb.	.13
Barium Carbonate, ppted., l.c.l., bags, works	lb.	.03
Benzene (Benzol), pure, drums, works	gal.	.19
Butyl Lactate, drums	lb.	.235
Cadmium Oxide, l.c.l., bbls.	lb.	.85
Calcium Carbonate (Ppted. chalk), U.S.P.	lb.	.05¾-.075
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.05¾-.06
Carbon Tetrachloride, l.c.l., drums	gal.	.73
Chrome, green, commercial, bbls.	lb.	.21
Chromic Sulphate, drums	lb.	.26¼
Cobalt Sulphate, drums	lb.	.65
*Copper, Acetate (verdigris), bbls.	lb.	.25
Carbonate, 53/55%, bbls.	lb.	.16
Cyanide, Tech., 100 lb. bbls.	lb.	.34
Sulphate, Tech., crystals, bbls.	lb.	.051
Cream of Tartar (potassium bitartrate), gran., bbls.	lb.	.34¾
Crocus Martis (iron oxide) red, tech., kegs	lb.	.07
Dibutyl Phthalate, l.c.l., drums	lb.	.195
Diethylene Glycol, l.c.l., drums, works	lb.	.155
Dextrine, yellow, kegs	lb.	.05-.08
Emery Flour (Turkish)	lb.	.07
Ethyl Acetate, 85%, l.c.l., drums, works	lb.	.075
Ethylene Glycol, l.c.l., drums, works	lb.	.17-.20
Flint, powdered	ton	30.00
Fluorspar No. 1 ground, 97-98%	ton	$60.00
Fusel Oil, refined, drums	lb.	.125-.14
*Gold, Chloride	oz.	$18¼-23
Cyanide, potassium 41%	oz.	$15.45
Cyanide, sodium 46%	oz.	$17.10
Gum, Arabic, white, powder, bbls.	lb.	.125-.14
Sandarac, prime, bags	lb.	.50
Hydrogen Peroxide, 100 volume, carboys	lb.	.20
Iron Sulphate (Copperas), bbls.	lb.	.017
Lead, Acetate (Sugar of Lead), bbls.	lb.	.11-.13¾
Oxide (Litharge), bbls.	lb.	.125
Magnesium Sulphate (Epsom Salts), tech., bag	lb.	.018
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Mercuric Oxide, red, powder, drums	lb.	$3.36
Nickel, Carbonate, dry, bbls.	lb.	.36-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.135-.145
Salts, double, 425 lb. bbls.	lb.	.135-.145
Paraffin	lb.	.05-.06
Perchlorethylene, drums	lb.	.08½
Phosphorus, red, cases	lb.	.42
yellow, cases	lb.	.40
Potash, Caustic, 88-92%, flake, drums, works	lb.	.07¼-.075
Potassium, Bichromate, crystals, casks	lb.	.09¼
Carbonate (potash) 98-100%, drums	lb.	.06¾
Cyanide, 94-96%, cases	lb.	scarce
Pumice, ground, bbls.	lb.	.03
Quartz, powdered	ton	$30.00
Quicksilver (Mercury), 76 lb. flasks	flask	$196.
Rochelle Salts, crystals, bbls.	lb.	.25¼
Rosin, gum, bbls.	lb.	5.25-7.75
*Silver, Chloride, dry, 100 oz. lots	oz.	.32
Cyanide, 100 oz. lots	oz.	.33½
Nitrate, 100 oz. lots	oz.	.27
Sodium, Carbonate (soda ash), 58%, bbls.	lb.	.0235
Cyanide 96%, 100 lb. drums	lb.	.15
Hydroxide (caustic soda) 76%, flake	lb.	.0355
Hyposulphite, crystals, bbls.	lb.	.035-.065
Metasilicate, granular, bbls.	lb.	.0335
Nitrate, tech., bbls.	lb.	.029
Phosphate, tribasic, tech., bbls.	lb.	.0295
Pyrophosphate, anhydrous, bbls., l.c.l.	lb.	.0580
Sesquisilicate, drums	lb.	.0425
*Stannate, drums	lb.	.35-.38
Sulphate (Glauber's Salts), crystals, bbls., works	lb.	.0135
Sulphocyanide, drums	lb.	.30-.35
Sulphur, Flowers, bbls., works	lb.	.037-.0410
*Tin Chloride, 100 lb. kegs	lb.	.39½
Toluene (Toluol), pure, drums, works	gal.	.32
Trichlorethylene, drums	lb.	.08½
Tripoli, powdered	lb.	.03
Wax, Bees, white, bleached, slabs 500 lbs.	lb.	.36-.40
Bees, yellow, crude	lb.	.24-.28½
Carnauba, refined, bags	lb.	.60-.70
Montan, bags	lb.	.27½-.30
Spermaceti, blocks	lb.	.24-.27
Whiting, Bolted	lb.	.025-.06
Xylene (Xylol), drums, works	gal.	.31
Zinc, carbonate, bbls.	lb.	.13½-.16
Cyanide, 100 lb. kegs	lb.	.33
Chloride, granular, drums	lb.	.06
Sulphate, crystals, bbls.	lb.	.04

*Subject to fluctuations in metal prices.